2014 Animal Behavior Conference Program

Conference Schedule
- **Thursday, 4/24**
- **Friday, 4/25**
  - Session I
  - Session II
  - Session III
  - Session IV
- **Saturday, 4/26**

Oral Presentation Abstracts
- **Thursday Speaker**
  - Session I
  - Session II
  - Session III
  - Session IV

Poster Abstracts
- A B C D E F G H J K L M O R S T Z

Symposium Abstracts

2014 Animal Behavior Conference Schedule

**Thursday, April 24th**

4:00–5:15 PM  **Plenary Speaker: Emilia Martins, Indiana University**
THE LONG VIEW: CAUSES AND CONSEQUENCES OF SIGNAL EVOLUTION

5:30–8:00 PM  **Poster Session** (IMU Dogwood, Persimmons, Sassafras Rooms - Abstracts)
Posters will remain on display until 12 PM Friday

**Friday, April 25th**

8:30–9:00 AM  **Breakfast** (a few breakfast items, coffee, tea)

8:55–9:00 AM  **Welcoming Remarks**
Cara Wellman, Interim Director of CISAB

**ORAL PRESENTATIONS (IMU Frangipani Room)**

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<th>Session</th>
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9:15 AM  **MPTP INDUCES SOCIOBEHAVIORAL CHANGES IN ZEBRAFISH, DANIO RERIO** (Abstract)

9:15–  **Alison Ossip-Klein, Indiana University**

9:30 AM  **HABITAT AND REPRODUCTIVE MODE PROFOUNDLY SHAPE THE EVOLUTION OF COLORFUL VISUAL**
SIGNALS ACROSS SCELORUS LIZARDS (Abstract)

9:30–  Kristyn Shreve, Miami University
9:45 AM THE INFLUENCE OF FOOD DISTRIBUTION AND RELATEDNESS ON THE SOCIAL BEHAVIOR OF FREE-ROAMING CATS (FELIS SILVESTRIS CATUS) (Abstract)

9:45–  Elizabeth Carlton, Indiana University
10:00 AM ENERGETIC REGULATION OF SEASONAL SICKNESS RESPONSES IN SIBERIAN HAMSTERS (PHODOPUS SONGORUS) (Abstract)

10:00–  Emily Moore, North Carolina State University
10:15 AM BEHAVIORAL DIVERSITY IN AFRICAN CICHLID FISH (Abstract)

10:15– Morning Refreshment Break
10:30 AM

SESSION Moderator: Liz Carlton

II

10:30–  Peter Dijkstra, Benedictine University
10:45 AM THE MELANOCORTIN SYSTEM LINKS COLOR AND SOCIAL BEHAVIOR IN THE CICHLID FISH ASTATOTILAPIA BURTONI (Abstract)

10:45–  Joseph Pochiro, The Ohio State University
11:00 AM TWO PROCESS ACCOUNT OF AVERSIVE CLASSICAL CONDITIONING: AMYGDALA MODULATION OF CEREBELLAR-DEPENDENT EYEBLINK CONDITIONING (Abstract)

11:00–  Tessa Solomon-Lane, Georgia State University
11:15 AM THE CENTRAL ROLE OF THE MIDDLE-RANKING FEMALE FOR BEHAVIOR AND REPRODUCTIVE SUCCESS IN BLUEBANDED GOBY (LYTHRYPNUS DALLI) SOCIAL GROUPS (Abstract)

11:15–  Krista Milich, Indiana University
11:30 AM THE GOOD OL' BOYS' CLUB: COALITION PATTERNS IN MALE Rhesus Macaques (Abstract)

11:30–  Sarah-Elizabeth Byosiere, University of Michigan
11:45 AM THE FUNCTION OF PLAY BOWS IN DYADIC CANID PLAY (Abstract)

11:45–  Robert Bowers, Indiana University
AM– 12:00 PM A BEHAVIOUR SYSTEMS ANALYSIS OF A CAUSAL REASONING DEMONSTRATION (Abstract)

12:00– LUNCH BREAK (Restaurant Guide)
1:30 PM

SESSION Moderator: Jakki Petzold

III

1:30–  Ronald Larkin, Illinois Natural History Survey
1:45 PM HIGH-ALTITUDE AERIAL ANTICS OF TEMPERATE NORTH AMERICAN BATS (Abstract)

1:45–  Lanikea King, Emory University
2:00 PM A SNP IN THE PRAIRIE VOLE OXYTOCIN RECEPTOR GENE PREDICTS ENHANCED PARTNER PREFERENCE FORMATION AND INDIVIDUAL DIFFERENCES IN OXYTOCIN RECEPTOR DENSITY IN THE NUCLEUS ACCUMBENS (Abstract)
2:00–2:15 PM  Susan Gershman, The Ohio State University at Marion  
THE SWEATPANTS EFFECT: MALE CHC ATTRACTIVENESS CHANGES WITH AGE AND MATING EXPERIENCE (Abstract)

2:15–2:30 PM  Sarah Rogers, Northeastern Illinois University  
PREVIOUS VISUAL EXPERIENCE MODIFIES PREDATORY BEHAVIOR IN SEVERAL SPECIES OF PRAYING MANTIS (Abstract)

2:30–2:45 PM  Rebekka Dohme, Indiana University  
FEMALE WING STROKING TO MALE SONG: FLOCK-LEVEL REGULATION OF VISUAL SIGNALING IN BROWN-HEADED COWBIRDS (Abstract)

2:45–3:00 PM  Afternoon Refreshment Break

SESSION Moderator: Alicia Rich Stout IV

3:00–3:15 PM  Wil Bogue, Northeastern Illinois University  
UTILIZING THE ELECTRORETINOGRAM TO ANALYZE PHOTORECEPTOR CIRCADIAN RHYTHMS IN THE COCKROACH, GROMPADORHINA PORTENTOSA (Abstract)

3:15–3:30 PM  Nikki Rendon, Indiana University  
CHANGES IN AGGRESSION CORRESPOND TO TRANSITIONS FROM A NON-REPRODUCTIVE TO REPRODUCTIVE STATE IN FEMALE SIBERIAN HAMSTERS (PHODOPUS SUNGORUS) (Abstract)

3:30–3:45 PM  Gregory Kohn, Indiana University  
EMERGENCE OF COMPETENCE: SOCIABILITY AND THE ONTOGENY OF COURTSHIP SKILLS IN FEMALE BROWN-HEADED COWBIRDS (MOLOTHRUS ATER). (Abstract)

3:45–4:00 PM  Awards Ceremony (Cara Wellman)

4:00–5:00 PM  PLENARY SPEAKER: Mark Blumberg, University of Iowa  
DEVELOPING THE SENSORIMOTOR SYSTEM IN OUR SLEEP (Abstract)

7:30–9:00 PM  Evening Reception  
Laura Hurley and G. Troy Smith's House (Map)

Saturday, April 26th

Satellite Symposium (Myers Hall Room 130)  
Sex: from codons to condoms, the mechanisms and consequences of sexual behavior.

9:25–9:30 AM  Opening Remarks

9:30–9:50 AM  Kelly Ronald  
BEAUTY IN THE EAR OF THE BEHOLDER?: LINKING HEARING AND MATE-CHOICE IN A SONGBIRD (Abstract)

9:50–10:05 AM  Andrew Stoehr  
COURTSHIP AND WING PATTERNS IN CABBAGE WHITE BUTTERFLIES (Abstract)

10:05–10:25 AM  Tierney Lorenz  
FUNCTIONAL IMMUNITY ACROSS THE MENSTRUAL CYCLE (Abstract)

10:25–10:45 AM  Morning Refreshment Break
10:45–11:05  **Jeremy Heath**  
AM  
CONFLICT BETWEEN SEXUAL AND NATURAL SELECTION: THE DUAL ROLE OF MALE MOTH COURTSHIP PHEROMONES ([Abstract](#))

11:05–11:50  **Justin Garcia**  
AM  
MODERN HUMAN DEVELOPMENT, SOCIOSEXUALITY, AND REGULATION OF REPRODUCTIVE STRATEGIES ([Abstract](#))

11:50 AM–1:45 PM  
LUNCH BREAK ([Restaurant Guide](#))

1:45–2:00  **Muchu Zhou**  
PM  
ASYMMETRIC COLOR-BASED SPECIES DISCRIMINATION IN ORANGETHROAT DARTERS ([Abstract](#))

2:00–3:00  
**KEYNOTE SPEAKER: Jim Pfaus**  
PM  
THE PLEASURE PRINCIPLE REVISITED: HOW SEXUAL REWARD LINKS SEXUAL AROUSAL, DESIRE, AND PREFERENCE ([Abstract](#))

### ORAL PRESENTATION ABSTRACTS

#### Thursday Speaker

1. **Emilia Martins (emartins@indiana.edu)**

   **TAKING THE LONG VIEW: CAUSES AND CONSEQUENCES OF SIGNAL EVOLUTION**

   E.P. Martins  
   Department of Biology, Indiana University, Bloomington, IN

   Large-scale comparative studies offer unique insight into the ancient evolutionary history, current constraints, and the outlook for future survival of animal species. For example, phylogenetic comparative analyses of 40+ species of Sceloporus lizards show that evolution of the headbob display has been shaped primarily by its function as a broadcast of territorial boundaries. More detailed analyses of new field data suggest that lizard species that have lost the conspicuous blue belly patches tend to use more motion displays, switching from a static color signal that is always present to dynamic signals that can be turned off in the presence of predators. Long-term evolutionary interactions between signals conveying similar information have also resulted in current trade-offs between the production and perception of visual and chemical cues. Switching to population-level comparisons of wild zebrafish, we find evidence for evolutionary interactions between different aspects of social behavior that both facilitate and constrain future response to climate change and other evolutionary forces.

#### Session I

1. **Ernesto Melchor Alonso (emelchor@neiu.edu)**

   **MPTP INDUCES SOCIOBEHAVIORAL CHANGES IN ZEBRAFISH, DANIO RERIO**

   E. Melchor Alonso, S. Saszik  
   Department of Psychology, Northeastern Illinois University, DeKalb, IL

   The purpose of the present research is to study the role of dopamine in social behavior via the effect of neurotoxin 1-methyl-4-phenyl-1, 2, 3, 6-tetrahydropyridine (MPTP). A random sample of 20 zebrafish, Danio rerio, underwent a shoaling response experiment where they were presented with a shoal of healthy conspecifics. Half of the sample was exposed to MPTP via immersions prior to experimentation while the rest...
were assigned as controls. The rate of proximity between the zebrafish and the side exposing the shoal were measured. A video-tracking analysis was conducted in order to compare both groups. It is predicted that the experimental group will experience a significant change in distance to the side of the tank exposing the shoal and their time spent in close proximity will significantly differ from that of the controls. Early results indicate that controls spend up to 75% of their time in the predicted tank locations. In other words, controls are moving towards and spending more time near the shoals on either side whenever the partition is removed. Results will add to the current body of research describing the neurodegenerative effect of MPTP on dopamine circuits and provide insight into the effect of neurodegenerative disorders on human social interactions.

Session I Schedule

2. Alison Ossip-Klein (aossipkl@indiana.edu)

HABITAT AND REPRODUCTIVE MODE PROFOUNDLY SHAPE THE EVOLUTION OF COLORFUL VISUAL SIGNALS ACROSS SCELOPORUS LIZARDS

A.G. Ossip-Klein¹, E.N. Smith², L. Chaudhari¹, D.K. Hews³, E.P. Martins¹

¹Department of Biology, Indiana University, Bloomington, IN, ²Department of Biology, University of Texas at Arlington, Arlington, TX, ³Department of Biology, Indiana State University, Terre Haute, IN

Habitat and reproductive mode are two powerful forces that have shaped visual signal evolution in reptiles. For example, arboreality has profoundly impacted the evolution of motion displays in lizards, and viviparity is a recurrent key innovation that impacts many phenotypic and ecological aspects in lizards. Using modern phylogenetic comparative and ancestral reconstruction methods, we explore the relative importance and timing of two key innovations, arboreality and viviparity, in shaping the evolution of colorful visual signals in a clade of lizards. We thus begin by reconstructing ancestral states for reproductive mode and microhabitat for 54 species of Sceloporus lizards. Our ancestral reconstructions indicate that the ancestor of all Sceloporus was likely terrestrial and laid eggs. Arboreality and viviparity evolved independently several times across the genus, with a handful of reversals. Shifts to an arboreal and viviparous lifestyle are also associated with shifts to larger ventral signaling patches in males, and habitat (arboreal vs. nonarboreal lifestyle) explains much of the interspecific variation in colorful patch size today. This aligns with previous findings that viviparous Sceloporus are unlikely to evolutionarily lose signaling patches, and arboreal lizards may rely more on the visual, rather than chemical signaling modality, for intraspecific communication.

Session I Schedule

3. Kristyn Shreve (shrevekr@miamioh.edu)

THE INFLUENCE OF FOOD DISTRIBUTION AND RELATEDNESS ON THE SOCIAL BEHAVIOR OF FREE-ROAMING CATS (FELIS SILVESTRIS CATUS)

K. Shreve¹, B. Keane², N.G. Solomon²

¹Institute for the Environment and Sustainability, ²Department of Biology, Miami University, Oxford, OH

Social behaviors serve many functions including competition for resources, resolution of conflicts, and stabilizing group dynamics. Social behaviors can be influenced by ecological and genetic factors. Ecological factors, such as clumped food, can increase intragroup competition and levels of agonistic behavior. As predicted by kin selection theory, genetically related individuals can increase their inclusive fitness by displaying altruistic behavior and relatives may display more affiliative behavior towards one another. We examined the effects of food distribution and relatedness to determine their influence on social interactions in a colony of free-roaming cats. Our goal was to determine if particular types of social behaviors vary with differences in relatedness and food distribution. To determine relatedness, individuals were genotyped at nine polymorphic microsatellite loci using DNA extracted from hair samples. Behavioral data were collected for 12 weeks and food was manipulated so it was dispersed or clumped. Behavioral data included frequencies of...
three types of behavior: affiliative, agonistic and investigatory. We compared frequency of behaviors to relatedness data for each type of food distribution. Investigatory behavior during the first dispersed food phase was the only behavior significantly and positively associated with relatedness. Food dispersion did not influence social interactions. These results indicate that feline social interactions may be influenced by other factors, such as familiarity, sex or personality. Additionally, chemical communication may be important in cats, as sniffing was the most common behavior observed. Investigation of these topics may provide more insight into factors influencing social behavior within animal groups.

**Session I Schedule**

**4. Liz Carlton (elcarlto@indiana.edu)**

**ENERGETIC REGULATION OF SEASONAL SICKNESS RESPONSES IN SIBERIAN HAMSTERS (PHODOPUS SUNGORUS)**

E.D. Carlton, G.E. Demas  
Department of Biology, Indiana University, Bloomington, IN

Sickness is an adaptive response generated to clear pathogens, but it carries great energetic costs. Seasonally breeding species exhibit seasonal variation in sickness responses. One hypothesis regarding this variation is that sickness intensity tracks an animal's energetic state, such that sickness is attenuated in the season in which an animal has the lowest fat stores. Energetic state may be signaled via leptin, a hormone that provides a signal of fat stores. Siberian hamsters are seasonal breeders that respond to short, winter-like days (SDs) by reducing fat stores and leptin levels, relative to those in long, summer-like days (LDs). Sickness is also attenuated in hamsters exposed to SDs as compared to LDs. We hypothesized that leptin provides a physiological signal by which animals modulate sickness, such that animals with higher leptin levels show increased sickness intensity. To test this, we provided SD hamsters with LD-like leptin signals and assessed their responses to lipopolysaccharide (LPS), a sickness-inducing antigen. We compared this response to SD-control, LD-control, and LD-leptin treated hamsters. Surprisingly, LPS induced hypothermia, rather than fever, in all groups. The SD-controls exhibited the greatest hypothermia, and leptin treatment attenuated this response, making hypothermia more LD-like. Alternatively, SD-leptin treated animals showed the least pronounced LPS-induced anorexia among all groups. These results suggest that leptin may mediate some, but not all, aspects of seasonal sickness variation and have prompted research into how other energetic signals may influence seasonal modulation of sickness.

**Session I Schedule**

**5. Emily Moore (ecmoore2@ncsu.edu)**

**BEHAVIORAL DIVERSITY IN AFRICAN CICHLID FISH**

E. Moore, R.B. Roberts  
Department of Biological Sciences, W.M. Keck Center for Behavioral Biology, North Carolina State University, Raleigh, NC

African cichlid fish are an excellent evolutionary model for studying diversity among many phenotypically divergent but closely related species in a natural context. The small evolutionary distance between species allows for the creation of interspecies hybrids in the lab, which can be used for gene mapping of quantitative trait loci (QTL) for species-specific traits. Because of this unique feature, laboratory lines of African cichlids can be used to examine the genetic basis of a variety of morphological and ecologically relevant phenotypes, including fundamental differences in how species use and investigate their environment. In order to identify behavioral differences between cichlid species, I modified classical behavior tests to quantify individual responses to novel environments, objects, and individuals in five wild-derived cichlid lines representing two genera. Recorded videos of each assay were analyzed with computer software to generate measures of movement (such as speed) and exploration (such as number of approaches to a novel object). Preliminary
findings suggest that both open field speed and novel object investigation differs by species, providing exciting prospects for future QTL mapping. By examining the genetic architecture of these behaviors, we will identify natural genetic variation that leads to behavioral differences between individuals. Since behavioral differences between species can act as barriers that maintain reproductive isolation, our studies should also lead to a better understanding of the speciation process, in addition to adding to our knowledge of how genetic differences lead to patterns of behavior.

**Session I Schedule**

**Session II**

6. Peter Dijkstra (pdijkstra@ben.edu)

**THE MELANOCORTIN SYSTEM LINKS COLOR AND SOCIAL BEHAVIOR IN THE CICHLID FISH ASTATOTILAPIA BURTONI**

P.D. Dijkstra¹,², T. Polanski¹, S.M. Maguire², R.M. Harris², S.A. Flores²†, H.A. Hofmann²

¹Department of Biology, Benedictine University, Lisle, IL, ²Section of Integrative Biology, The University of Texas at Austin, Austin, TX

In many cichlid species, phenotypic differentiation in male coloration is correlated with a corresponding differentiation in the intensity of male territoriality. We tested whether the melanocortin system acts as a pleiotropic mechanism that links color and behavior in the African cichlid fish Astatotilapia burtoni, where males display either yellow or blue coloration and compete for territorial dominance in a lek-like social system. Melanocortins such as ?-MSH (melanocyte stimulating hormone), derived from the pro-opiomelanocortin (POMC) precursor, are known to regulate color, mainly through the melanocortin 1 receptor. In addition, melanocortins bind to four other receptors in central and peripheral tissues, where they regulate a range of physiological and behavioral functions. We first showed that yellow males are more aggressive and have lower levels of the stress hormone cortisol than blue males. Using i.p. injections we found that ?-MSH increased yellow coloration. Moreover ?-MSH had a morph-specific effect on behavior in that only blue males increased the rate of agonistic behavior after injection, suggesting that the melanocortin system is more activated in yellow males. However, there was no differential gene expression of melanocortin-related genes in the hypothalamic pre-optic area. To our surprise, transcript level analysis in skin tissue indicated higher activation of the melanocortin system in blue males. Ongoing experiments focus on the molecular and neural processes underlying these effects.

**Session II Schedule**

7. Joseph Pochiro (pochiro.1@buckeyemail.osu.edu)

**TWO PROCESS ACCOUNT OF AVERSIVE CLASSICAL CONDITIONING: AMYGDALA MODULATION OF CEREBELLAR-DEPENDENT EYEBLINK CONDITIONING**

J.M. Pochiro¹,², D.H. Lindquist¹

¹Department of Psychology, ²Department of Neuroscience, The Ohio State University, Columbus, OH

In delay eyeblink conditioning (EBC) a neutral conditioned stimulus (CS; tone) is repeatedly paired with a mildly aversive unconditioned stimulus (US; eye-shock). Acquisition of the eyeblink conditioned response (CR) relies on the cerebellum and brainstem. Early in training, the amygdala is proposed to associate the context and US, resulting in multiple emotional (fear) CRs (e.g., freezing). The amygdala also amplifies neuronal activity in the pontine nucleus, which relays CS information to the cerebellum, promoting more robust synaptic plasticity and association of the CS -US. In the current study, the central nucleus of the amygdala (CEA) is lesioned in order to assess the consequences on both fear and eyeblink CR acquisition and expression. All rats (lesion/sham) are submitted to one or four sessions of delay EBC. Freezing behavior is proposed to be maximal during the
first training session, whereas the eyeblink CR frequency starts low and increases across the four sessions. The level of neuronal responding in the pontine nucleus will be quantified via immunohistochemical detection of c-Fos, an immediate early gene preferentially expressed in spiking neurons. Lesioned animals relative to controls are predicted to display less freezing behavior, lower c-Fos expression in the pontine nucleus, and slower eyeblink CR acquisition.

Session II Schedule

8. Tessa Solomon-Lane (tsolomonlane1@student.gsu.edu)

THE CENTRAL ROLE OF THE MIDDLE-RANKING FEMALE FOR BEHAVIOR AND REPRODUCTIVE SUCCESS IN BLUEBANDED GOBY (LYTHRYPNUS DALLI) SOCIAL GROUPS

T.K. Solomon-Lane1, D.S. Pradhan2, M.M. Williams3, M.C. Willis2, L. Rogers3, M.S. Grober2

1Neuroscience Institute, Georgia State University, Atlanta, GA, 2Department of Biology, Georgia State University, Atlanta, GA, 3Department of Biology, Agnes Scott College, Decatur, GA

Agonistic behavior and reproduction are closely tied in social species, and the connection is largely determined by social group structure. For example, status in social hierarchies is associated with behavior and reproductive success. Often, the dominant member of a hierarchy is the primary focus for understanding the behavioral and reproductive dynamics of the social group; however, other statuses can be influential. The bluebanded goby (Lythrypnus dalli) is a highly social, sex-changing fish that forms linear hierarchies of one dominant male and multiple subordinate females. We have identified agonistic behaviors in each social status that are associated with reproduction and were surprised to find a central role for the middle-ranking (beta) female. In stable groups (1 male, 3 females), male reproductive success was negatively associated with aggression directed specifically at the beta. Beta agonistic efficiency, or the proportion of approaches that led to a displacement, was the only behavioral measure from any group member that was positively associated with male reproductive success. In these same groups, alpha and beta females were equally likely to appear gravid over time, but only beta gravidity was associated with male reproductive success. Finally, beta’s reproductive state (gravid vs. non-gravid) had a subtle but significant effect on the group’s social network, including the centrality of the beta and male; alpha gravidity had no effect. Although the male was clearly dominant in these groups, our data support a focal role for beta as an indicator of and influence on behavior and reproduction.

Session II Schedule

9. Krista Milich (kmilich@indiana.edu)

THE GOOD OL' BOYS' CLUB: COALITION PATTERNS IN MALE RHESUS MACAQUES

K. M. Milich1,2, D. Maestripieri2

1Kinsey Institute, Indiana University, Bloomington, IN, 2Institute for Mind and Biology, University of Chicago, Chicago, IL

Male coalitions have been documented in a variety of primate species; however, there is a great deal of interspecific variation in who is involved and when they are formed. Despite the widespread occurrence of male coalition formations across the genus Macaca, researchers have rarely observed these coalitions in rhesus macaques (Macaca mulatta). Here, we examine polyadic aggression in high ranking male rhesus macaques on the island of Cayo Santiago, Puerto Rico. We test three potential hypotheses for the occurrence of polyadic aggression: 1) to improve rank, 2) to improve relationships with others, and 3) to protect weaker individuals. The study was conducted during the mating season, from mid-February to mid-July 2013. Study subjects were 21 adult male rhesus macaques belonging to 8 groups. For each polyadic interaction, the dominant individual, subordinate individual, and any other individuals present were recorded. The context (i.e. food, sex, intergroup interactions) was recorded for each episode. Within each group, high ranking male rhesus macaques support each other most often, followed by supporting females. Of the observed coalitions, 49% were between the top
3 highest ranking males in each group, 34% were supporting females, and 17% were in support of other (lower ranking) males. Males supported higher ranking males more than lower ranking males (p=0.043) and females more compared to low ranking males (p=0.030). These data suggest that male rhesus macaques use coalitions to improve their relationship with high ranking males and their relationship with potential female mating partners.

Session II Schedule

10. Sarah-Elizabeth Byosiere (sarahbyo@umich.edu)

THE FUNCTION OF PLAY BOWS IN DYADIC CANID PLAY

S. Byosiere, B. Smuts
Department of Psychology, University of Michigan, Ann Arbor, MI

Domestic dogs are thought to use play bows not only to initiate play, but as a form of meta-communication to clarify a dog's intentions in play (Bekoff 1972). The only study we know of determining play bow functionality found that play bows often preceded or followed an action that could be perceived as aggressive outside the context of play (Bekoff 1995), thus potentially serving as an indicator of benign intent. However, more recent evidence suggests that play bows more often accompanied self-handicapping behaviors than offensive behaviors (Bauer & Smuts 2007). To further examine the function of play bows, we analyzed offensive, defensive and pause behaviors that occurred right before, and after play bows within a dyadic pair. The results present contradictory evidence to Bekoff (1995) suggesting that play bows are used by the bower to entice the partner into initiating, or re-initiating a play bout rather than defining a potentially ambiguous play atmosphere.

Session II Schedule

11. Robert Bowers (ribowers@indiana.edu)

A BEHAVIOUR SYSTEMS ANALYSIS OF A CAUSAL REASONING DEMONSTRATION

R.I. Bowers, W.D. Timberlake
Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN

Rats deal well with cause and effect, but how and whether to apply theories of causal reasoning remains controversial. We present one solution, an analysis of causal reasoning within the behaviour systems framework of classical ethology. We focus on a demonstration of rats displaying patterns of behaviour predicted by a normative theory of causal reasoning, Bayes Networks. This has elsewhere been taken to suggest a general capacity for reasoning with abstract, mental models of causal relations. Others have argued that such evidence for causal reasoning can be dismissed as an artefact of the experimental circumstance. Continuous and finer-grained measurement of a broader range of responses shows that neither the dismissive account, nor the abstract mental modeling account are consistent with a more complete view of the behaviour of subjects in these experiments. Use of normative theories of causal reasoning may be appropriate, and provide a complementary source of insight to how rats solve causal problems, but consistency with such theories does not imply abstractness, generality of process, nor causal-model representations. Rather, the present results appear most consistent with a view that rats display rational norms in a problem-specific manner, with the focal experiment evoking a specifically predatory pattern. The analysis furthermore identifies associated patterns of behaviour that normative theories of causal reasoning lack sufficient breadth to predict, suggesting new directions for an integrative approach to study of how rats deal with cause and effect.

Session II Schedule

Session III
12. Ronald Larkin (r-larkin@illinois.edu)

HIGH-ALTITUDE AERIAL ANTICS OF TEMPERATE NORTH AMERICAN BATS

R. Larkin\textsuperscript{1,2} \textsuperscript{1} Illinois Natural History Survey, \textsuperscript{2}Department of Animal Biology, University of Illinois, Champaign, IL

Migratory tree bats, which are not well-studied, are of intense interest because of their high casualty rate at wind turbines. Tracked second-by-second in three dimensions with radar that can also show "fluttery" wing beats, they engaged in complex behavior during the fall migratory period in Vermont, Pennsylvania, and Illinois. Convoluted flights sometimes exceeding 30 minutes took place with no obvious relationship to the underlying terrain. Bats often ascended to great heights sometimes exceeding 1 km, remained stationary in the wind (818 "hovers" of 21 to 117 seconds), and periodically descended briefly and rapidly as if prey-catching (148 "swoops" at 47 to 1,420 m above the ground). Although the functions of these spectacular flights are open to speculation, further serendipitous radar data suggest that the bats interact with each other socially and take advantage of high-flying arthropods such as moths. The observations were quantified with computer algorithms that counted the behaviors and measured speeds, spatial extents, etc.

Session III Schedule

13. Lanikea King (king.lanikea@gmail.com)

A SNP IN THE PRAIRIE VOLE OXYTOCIN RECEPTOR GENE PREDICTS ENHANCED PARTNER PREFERENCE FORMATION AND INDIVIDUAL DIFFERENCES IN OXYTOCIN RECEPTOR DENSITY IN THE NUCLEUS ACCUMBENS

L.B. King, K. Inoue, L.J. Young
Center for Translational Social Neuroscience, Yerkes National Primate Center, Emory University, Atlanta, GA

Diversity in brain oxytocin receptor (Oxtr) expression associates with both species and individual social behavior differences. In monogamous prairie voles there is remarkable individual variation in OXTR density in the nucleus accumbens (NAcc) that is not present in non-striatal brain regions and this variation appears to modulate affiliative behaviors. We report that a single nucleotide polymorphism, SNP2, in the 3'-untranslated region of the prairie vole Oxtr exhibits allelic imbalance (AI) in the NAcc but not other regions. AI indicates that cis-regulatory polymorphisms modulate transcription of Oxtr, an effect confined to NAcc. Interestingly, we observed consistently higher expression of the T-allele compared with the C-allele in the AI data. Therefore, we hypothesized that prairie voles with T/T genotypes would display higher levels of total OXTR density in NAcc than C/C voles. We also hypothesized that the SNP2 T/T genotype would be associated with enhanced social behavior. Receptor autoradiography was performed on brain sections from adult T/T and C/C voles to determine OXTR density. T/T voles had a two-fold higher OXTR density than C/C littermates in the NAcc. OXTR density did not differ between genotypes in two other brain regions analyzed. Additionally, male T/T voles formed a partner preference after a short 6-hour cohabitation, while C/C males did not. We demonstrate a strong transcriptional modulation of OXTR expression specifically in NAcc and confirm that associated genotypes predict individual differences in social cognition.

Session III Schedule

14. Susan Gershman (gershman.6@osu.edu)

THE SWEATPANTS EFFECT: MALE CHC ATTRACTIVENESS CHANGES WITH AGE AND MATING EXPERIENCE

V.L. Templer, R.R. Hampton
Department of Psychology, Emory University, Atlanta, GA
One important aspect of episodic memory is the ability to remember the order in which sequences of events occurred. However, the cognitive mechanisms underlying memory for sequences have not been determined. We presented monkeys with lists of five images drawn randomly from a pool of 6,000 images. At test, two images were presented and monkeys were rewarded for selecting the image that had appeared earlier in the studied list. Monkeys learned to discriminate the order of the images, even those that were consecutive in the studied list. In subsequent experiments we found that discrimination of order was not controlled by list position or relative memory strength. Instead, monkeys used temporal order, a mechanism that appears to encode order of occurrence relative to other events, rather than in absolute time. We found that number of intervening images, rather than passage of time per se, most strongly determined the discriminability of order of occurrence.

Session III Schedule

15. Sarah Rogers (s-rogers3@neiu.edu)

PREVIOUS VISUAL EXPERIENCE MODIFIES PREDATORY BEHAVIOR IN SEVERAL SPECIES OF PRAYING MANTIS

S. Rogers, R. Thompson, M. Garcia, F. Prete
Department of Biology, Northeastern Illinois University, DeKalb, IL

In general, behavior can be modulated by the effects of prior experience, and research in our lab has shown this to be true for praying mantises (Insecta: Mantodea). For instance, when shown a computer animated stimulus, predatory responses to the stimulus can be suppressed when it is preceded by a much larger stimulus, indicating that the mantis' visually elicited behavioral responses are dynamic. To test the extent to which prior visual experience affects mantis strike rate, several species were shown two computer animated disk-shaped stimuli: a stationary "prime" and a moving "target" stimulus; the prime was 6.4, 8.7, or 24.1 degrees of visual angle (deg); the target was 12.2 deg. Trials alternated between those in which the target appeared alone and those in which the target was immediately preceded by the prime. In the latter case, the prime flashed on and off either two or three times after which the target moved in a figure eight pattern around visual field center and then disappeared. Results demonstrated that strike rate was suppressed by primes in all cases. Further, the greater the difference in size between the prime and the target stimulus, the greater the suppressive effect. Our results suggest that the mantis' predatory responses are influenced by prior visual experience, and their behavior is modified accordingly. This indicates a level of complexity incongruent with the often simplistic view of invertebrate physiology and behavior, and challenges the assertion that invertebrates operate with machine-like predictability.

Session III Schedule

16. Rebekka Dohme (redohme@indiana.edu)

FEMALE WING STROKING TO MALE SONG: FLOCK-LEVEL REGULATION OF VISUAL SIGNALING IN BROWN-HEADED COWBIRDS

R. Dohme, A.P. King, G.R. Meredith, M.J. West
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This research focused on how flocks of adult female brown-headed cowbirds, Molothrus ater, provide feedback to young males developing their songs. The behavior of interest was a rapid female wing movement termed the wing stroke that co-occurs with male song. Wing strokes are of interest because they shape male song and predict song quality. We studied eight flocks of high and low female-to-male ratios chosen to represent different amounts of female feedback. The same pattern of female feedback emerged in seven out of eight flocks: One female produced the majority of wing strokes to male song. There was also a significant correlation between the amount of wing strokes a female produced and how much other females approached her. Finally, primary wing strokers approached males less than non-primary wing strokers and thus were more selective in
their interactions with males. Previous studies have reported this type of social selectivity to facilitate faster song acquisition. This research is the first to document a group-level behavior that enables socially selective females to provide the most visual feedback to male song.

Session IV Schedule

**Session IV**

17. Wil Bogue (wilbogue@gmail.com)

**UTILIZING THE ELECTRORETINOGRAM TO ANALYZE PHOTORECEPTOR CIRCADIAN RHYTHMS IN THE COCKROACH, GROMPADORHINA PORTENTOSA**

W. Bogue, A. Urdilales, E. Mantes, A. Schirmer, F. Prete  
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The electroretinogram (ERG) is a sub-corneal, extracellular recording reflecting the summed electrical responses of the compound eye photoreceptors in response to square wave light pulses. Previous studies using several species of cockroach have shown the ERG to be a robust technique by means of which to analyze changes in photoreceptor activity under various experimental conditions. Our experiments have revealed that Grompadorhina Portentosa's ERG is a complex waveform consisting of four distinct components: a transient and a sustained ON potential that are elicited by light stimulus onset, and a transient and sustained OFF potential elicited by stimulus OFFSET. ERG recordings taken at 15 min intervals over 96 continuous hours under constant light conditions revealed circadian rhythms in the sustained ON and OFF ERG components reflecting oscillations in photoreceptor sensitivity. Further analysis revealed rhythmic changes in the latencies to the maximum amplitudes of both the sustained ON and OFF potentials indicating photoreceptor responses to light were faster during the day phase than during the night. Interestingly, these circadian fluctuations only emerged after the roach was adapted to experimental set-up for 1-2 days. This first analysis of G. portentosa's ERG provides a novel source of data regarding the cellular and physiological changes in its visual system. We believe that these changes well adapt the roach to its generally dimly lit ecological niche among detritus on the forest floor. Future research will examine the molecular underpinnings of these circadian oscillations in G. Portentosa's visual physiology.

Session IV Schedule

18. Nikki Rendon (nrendon@indiana.edu)

**CHANGES IN AGGRESSION CORRESPOND TO TRANSITIONS FROM A NON-REPRODUCTIVE TO REPRODUCTIVE STATE IN FEMALE SIBERIAN HAMSTERS (PHODOPUS SUNGORUS)**

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Seasonally breeding animals exhibit profound physiological and behavioral responses to changing photoperiods, including changes in reproduction and territorial aggression. We have demonstrated increased aggression in Siberian hamsters during short "winter" days (SDs) during reproductive quiescence, suggesting that changes in aggression are inversely related to reproductive function. It is unknown, however, whether these seasonal differences in aggression are mediated by photoperiod or reproductive state. Gonadally regressed Siberian hamsters experience spontaneous gonadal recrudescence following prolonged exposure to SDs and have reproductive physiology similar to long "summer" day (LD) animals. We used natural fluctuations in reproduction in SD animals to disentangle the effects of photoperiod from reproductive state. Specifically, female hamsters were housed in LDs or SDs for 10, 24 or 30 weeks. These times capture variation in reproductive state following 1) gonadal regression, 2) transition back to a reproductively active state, and 3) full gonadal recrudescence, respectively. LD animals maintained reproductive physiology and displayed low levels
of aggression across all time points. By week 10, SD animals underwent gonadal regression and displayed increased aggression. Further, recrudesced females have estradiol levels comparable to LD animals, suggesting that elevated estradiol may be a mechanism underlying reproductive, but not non-reproductive, aggression. This study illustrates that seasonal differences in aggression are driven by reproductive state, rather than photoperiodic cues, per se. Collectively, these results broaden our understanding of seasonal adaptation by examining the linkage between aggressive and reproductive seasonal phenotypes.

Session IV Schedule

19. Gregory Kohn (gmkohn@indiana.edu)

EMERGENCE OF COMPETENCE: SOCIABILITY AND THE ONTOGENY OF COURTSHIP SKILLS IN FEMALE BROWN-HEADED COWBIRDS (MOLOTHRUS ATER)

G. Kohn
Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN

Individuals often exhibit consistent variation in their willingness to initiate social interaction with others, or sociability. Early variation in sociability may influence the development of courtship skills by exposing juveniles to different levels of social contact. Here I investigated how early sociability reflects the ontogeny of courtship skills in Brown-headed Cowbirds. During autumn I used a fission-fusion perturbation on a flock of juvenile cowbirds, and recorded social interaction patterns across contexts. Juveniles were then observed the following breeding season. Females who consistently initiated more social interactions during the fall were more likely to be pair-bonded during the breeding season, and respond to male song displays using a 'chatter' vocalization. In previous studies we discovered that adult females who used more response chatters laid more eggs than other females. These results suggest that early and consistent variation in sociability reflects the development of courtship behaviors needed for successful reproduction in adulthood.

Session IV Schedule

20. Plenary Speaker: Mark Blumberg (mark-blumberg@uiowa.edu)

DEVELOPING THE SENSORIMOTOR SYSTEM IN OUR SLEEP

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How are the "rudimentary" movements of fetuses and infants transformed into the coordinated, flexible, and adaptive movements of adults? Some believe that adult behaviors are built from "motor primitives," endowed units of behavior, hardwired in the spinal cord, that arise fully formed without the need for experience. In contrast, an increasing number of developmental scientists and roboticists are emphasizing how infants discover how their bodies are built. Not surprisingly, this process of discovery has been presumed to occur only when infants are awake, reflecting the common wisdom that sleep is a period of sensory isolation and behavioral stillness. But this is far from the truth. Instead, during active (or REM) sleep, every skeletal muscle in our body twitches, causing jerky movements of the arms and legs, fingers and toes, eyes, and (in rodents) whiskers. These movements are particularly prominent during the perinatal period when active sleep predominates. Although considered for millenia to be by-products of dreams (think dogs "chasing rabbits"), research in infant rodents over the past decade has fundamentally altered our conception of the neural causes and functional consequences of this behavior, with important implications for our understanding of typical and atypical development and recovery of function after injury or disease. The most recent work from my laboratory is now showing that twitches are uniquely different from wake movements with regard to how they are processed by the sensorimotor system. This surprising feature of twitching may hold the key to understanding its role in driving activity-dependent development of the sensorimotor system.
POSTER ABSTRACTS

1. Mohammad Alsayegh (malsaye1@slu.edu)

CRAYFISH USE OF SENSORY MODALITIES IN FORAGING

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Aquatic organisms can use several sensory modalities to find food. Although aquatic organisms may have numerous sensory modalities available, as a group, they tend to rely more heavily on visual and chemical modalities. Crayfish are found in a variety of aquatic habitats such as along the edges of rivers, streams and lakes. These habitats can vary in light intensity due to variation in the amount of canopy cover, leaf litter, and dissolved sediments. Crayfish have well developed visual and chemical senses but it is unclear the relative importance of each of these sensory modalities in finding food. In order to assess the relative importance of these signal types we examined the time it took for crayfish to locate a food item when exposed to only chemical cues, visual cues, or a combination of the two. Our experimental design included two small clear containers placed at opposite ends of a 10-gallon aquarium with a loose gravel substrate. We placed food in one container and left the other empty. In the chemical cue only condition, both containers were opaque but unsealed. In the visual only condition, the container was transparent but sealed. In the combination condition, the containers were transparent and unsealed. Trials began by placing a crayfish in a tube in the middle of the aquarium and allowing it to acclimate to the test chamber. We videotaped all trials and measured latency, duration, and accuracy. We will present our preliminary findings.

2. Katherine Anderson (anders85@miamioh.edu)

GENETIC STRUCTURE IN PRAIRIE VOLES, MICROTUS OCHROGASTER

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Mapping the genetic structure of animal populations can reveal connections between social systems, relatedness, and dispersal. Such genetic data can impart information about the tendency of individuals within populations for philopatry, inbreeding, and kin selection. The prairie vole, Microtus ochrogaster, is unusual among mammals in that the species is socially monogamous and males and females both disperse, though males disperse further from the natal nest than females. Here, the fine-scale genetic structure of two natural populations of prairie vole was analyzed using six polymorphic microsatellite loci. The two natural populations studied, one in Kansas and the other in Indiana, are known to differ in levels of social monogamy. Prairie voles display short distance dispersal, tend to form groups and engage in cooperative breeding, therefore we predicted that there would be some clustering among related individuals. Our analyses reveal no evidence of kin clustering among resident adults of either sex in either natural population. The short life-span of prairie voles may prevent any kin clusters from forming. Thus, there appears to be limited opportunities for kin-biased social interactions because related individuals are not spatially clustered.

3. Jesse Balaban-Feld (jbalaban@slu.edu)

REPEATABILITY OF MALE MATING PREFERENCE IN DROSOPHILA MELANOGASTER
Male mate choice has been reported across many taxa, but less is known about its consistency. Mating status of the prospective female is an important factor that affects the quality of a mate: virgin females should be preferred as mates compared to mated females. We directly observed the courtship and mating behavior of male Drosophila melanogaster who were given the opportunity to simultaneously court and copulate with one virgin and one mated female. Each male was tested three times in one day. The 30 males studied exhibited a strong mating preference for virgins. Out of 84 successful copulations, males mated with the virgin 83 times. Furthermore, 25 out of 30 males spent the majority of their courtship time pursuing the virgin female. In contrast to the consistency in mating behavior, we observed much variation in male courtship behavior and consistency across trials. There was no significant repeatability between the first and second trials. However, there was significant repeatability in percent of time courting the virgin when examining trials 2 and 3. This suggests that experience and learning about variation in female quality in the population can affect male courtship behavior. The analysis of male courtship and mating behaviors has important implications into how male mate preference can shape sexual selection.

4. Kevin Barnes (kevin.w.barnes@gmail.com)

ASSESSING THE ROLE OF SOCIAL INFORMATION ON CERULEAN WARBLER SETTLEMENT

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Breeding bird distributions are often aggregated within large tracts of seemingly suitable habitat. Research suggests that an aggregated distribution could be a behavioral response to social information. We conducted a field experiment to determine if inadvertent social information influences Cerulean Warbler (Setophaga cerulea) settlement. We broadcasted male Cerulean Warbler vocalizations within mature deciduous forest that did not have an established breeding population in the past 6 years. Treatment and control plots were divided into higher quality and lower quality habitat to assess the strength of social information on Cerulean Warbler settlement. Broadcast systems were deployed from 15 April to 23 July 2013 in Morgan-Monroe State Forest, Indiana and point counts were conducted within treatment and control plots every 3-6 days. There were no established territories in 2013 within control or treatment plots. Treatment and control plots will be surveyed again in 2014 to determine if post-breeding cues heard in 2013 by dispersing individuals influence settlement in those areas the following spring. Speakers will be deployed again in 2014 in another research area in an aggregated arrangement to determine if Cerulean Warbler settlement is influenced by breeding aggregations.

5. Oliver Beckers (obeckers@indiana.edu)

A COMPLEX PATCHWORK OF DEVELOPMENTAL PLASTICITY, PARENTAL EFFECTS, AND GENETIC DIFFERENTIATION MEDIATES DIVERGENCES IN LIFE HISTORY TRAITS BETWEEN EXOTIC DUNG BEETLE POPULATIONS

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The dung beetle Onthophagus taurus was introduced < 50 years ago from the Mediterranean into Australia and the U.S. The intra- and interspecific competition for breeding resources (i.e., dung) differs tremendously between these two exotic ranges. Here, we investigate (1) if these differences in resource competition have led to divergences between Western Australian (WA) and Eastern U.S. (EUS) populations in life history traits that are related to resource use and (2) what the proximate mechanism underlying these divergences are. We predicted that the high level of resource competition in WA has favored females that produce brood balls (a) more efficiently, (b) but at a smaller (or bigger) size, produce offspring (c) more readily when a breeding opportunity arises, and that these offspring have (d) a higher eclosion success, (e) eclose to adulthood at a smaller adult body size, and (f) complete larval development faster than EUS beetles. We find that field-
collected animals significantly differed as predicted in almost all of these life history traits. Next, we test if these divergences between populations were facilitated by genetic differentiation, developmental plasticity, or parental effects by rearing multiple generations in a common garden environment. We find that developmental plasticity and (grand) parental effects mediated differences in traits related to reproductive performance and genetic differentiation mediated differences in the duration of larval development and adult body size. Our study highlights that population divergences in life history traits can be the result of a surprisingly complex patchwork of proximate mechanisms.

6. Robert Bowers (ribowers@indiana.edu)

ORDER EFFECTS IN HUMAN MATE-CHOICE COPYING: DO WE COPY TO CUT COSTS, IMPROVE QUALITY, OR FOR SPEED?

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Information about the mate choices of others is abundant and available for use by observers making their own mate choices. In humans and several other studied species, preference is often shown for mates that are apparently preferred by others (mate-choice copying). Humans have access to a great deal of social information from multiple models choosing and rejecting mates. Such information is generally received serially, with a specific temporal order. Hypotheses regarding the functional value of mate-choice copying are hard to differentiate, but differ in how they expect temporal order of information to affect the way it is used. In particular, views that stress time pressures predict that earlier observations of mate choice will be used disproportionately--a primacy effect--for quick decisions. In contrast, for views that stress other costs of active mate assessment or informational benefits of copying, later and earlier observations should be treated similarly, assuming they are equally informative and equally cheap. Memory decay may predict later instances having greater impact, a recency effect. To test these possibilities, we had female subjects view sets of real speed-dating videos each featuring a focal male with a series of three female models. Observed order effects support views that stress pressures on quick decision making. Discerning the effects of order is important not only for a complete description of the function of mate-choice copying, but furthermore such analyses begin to address questions about mechanism, helping to differentiate among models of cognitive processing.

7. Benjamin Brier (bebrier@indiana.edu)

NESTING AND PARENTAL BEHAVIOR IN MALE AND FEMALE ZEBRA FINCHES IS MODULATED BY ENDOGENOUS VPAC RECEPTOR ACTIVATION

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Vasoactive intestinal polypeptide (VIP) and its cognate VPAC receptor are present in virtually every brain area that is known to be important for social behavior, including all nodes of the core "social behavior network," yet the social functions of VIP circuits remain little known. However, recent data from our lab show that VIP mRNA and/or VIP-Fos colocalization is correlated with nesting behavior in male and female zebra finches (Taeniopygia guttata). Using central infusions of a VPAC antagonist (both intracerebroventricular and intraseptal), we now demonstrate that activation of VPAC receptors is indeed required for the normal expression of nesting behavior in both males and females, and highlight the septum as an important site of action. However, contrary to expectations, VPAC antagonism actually increases incubation time and nestling care (feeding trips). Hence, VPAC receptors may exert effects on behavior that are specific to each reproductive phase.

8. Shannon Butler (shannon.rhey.butler@gmail.com)

DID YOU SEE THAT? EUROPEAN STARLINGS FOLLOW THE GAZE DIRECTION OF CONSPECIFICS
Reorienting gaze to where others are looking facilitates social interactions and transmits information through groups. Since European starlings follow the gaze direction of humans, we asked whether starlings follow the gaze direction of conspecifics. In an experimental paradigm where we manipulated the gaze of robotic conspecifics, we measured whether live individuals followed the gaze of a robotic conspecific. Due to the difficulty in determining where animals with laterally placed eyes are looking, our paradigm consisted of the robot looking behind a barrier into an empty compartment, which the live bird could view through two small windows. We used the projections of the live bird's centers of acute vision to approximate gaze direction. The live bird was significantly more likely to look through the window into the empty compartment when the robot was also looking, compared to when the robot was not looking. We also examined the mechanism that starlings used to gather information from the conspecific robot. Interestingly, the head movement rate (HMR) was predictive of the behavior of the live bird: birds who looked through the window had a higher HMR rate before they approached the window compared to birds who did not approach the window. This suggests that birds who looked through the window invested more energy in gathering information than the birds who did not look through the window. Overall, these findings provide insights into a behavioral mechanism that could be used to transmit information through flocks, influencing fitness through predator detection and social interactions.

9. Stephanie Campos (smcampos@indiana.edu)

**VARIATION IN LIPID COMPOSITION OF FEMORAL GLAND SECRETIONS FROM FOUR SPECIES OF SCELOPORUS: A PRELIMINARY ANALYSIS**

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Early-life social behaviors appear to be important for appropriate brain development and adult behavior. Two distinct forms of early-life social behavior have been well documented in rats: mother-pup interactions and juvenile play-fighting behavior. The purpose of this study was to investigate if there were associations between these two forms of behavior. Long-Evans rats were videotaped weekly beginning at postnatal day 14 through postnatal day 41. During the first week, interactions between pup, mother, and a littermate were recorded over a 20-minute period. During the last three weeks, interactions between three cagemates were recorded over a 20-minute period weekly. The measures taken during the mother-pup session were then correlated with measures of total expressive and receptive play-fighting interactions generated during the last three weeks of testing. Notably, there were few scores from the mother-pup observations that significantly correlated with later play-fighting scores. This may reflect the small number of animals involved in the study or the lack of sensitivity in some measures. However, the number of contacts directed by a mother towards a pup and the pup's own activity were significantly correlated with total receptive play-fighting interactions during later development. Overall, mother-pup interactions and later play-fighting behavior may represent autonomous aspects of social development in normal laboratory rats. Nonetheless, it remains possible that large-scale alterations of maternal behavior or pup reactivity to such behavior can significantly modify later play-fighting behavior.

10. Nandita Chittajallu (nchittaj@umail.iu.edu)

**FACTORS MEDIATING MOUSE PUP NIPPLE ATTACHMENT**
Attaching to a nipple and suckling are paramount to the survival of infant mammals. When deprived of maternal care and subsequently of mother’s milk, mouse pups rapidly and frequently attach to a nipple. Factors reinstating normative pup nipple attachment are currently unknown but may include maternal care, satiety from mother’s milk, heat, or any other number of stimuli. Postnatal day (PND) 4, 8, and 12 mouse pups were separated from the mother and assigned to one of four treatment conditions: no-care/no-nutrition, maternal care/no-nutrition, nutrition/no-care, or oral stimulation/no-nutrition. Following 2 or 4 hours of separation from the mother, pups were tested in a nipple attachment test. Latency and probability of attachment to a nipple were recorded. The pups within the no-care/no-nutrition condition showed significantly decreased latencies and increased probabilities to attach relative to the other conditions. PND 4, 8, and 12 pups in the no-care/no-nutrition condition differed significantly from pups in the maternal care/no-nutrition condition demonstrating a robust and reliable effect of maternal care on nipple attachment latencies. Within the maternal care/no-nutrition condition, PND 4 pups showed significantly decreased attachment latencies and increased probabilities to attach compared to PND 12 pups suggesting a transition in ingestion from being externally mediated to internally mediated. There was no significant difference between the nutrition/no-care group when compared to the oral stimulation/no-nutrition group suggesting some other aspect of the procedure is driving our results. To mitigate the possible attenuating effects of the no-care/nutrition condition, we will intubate pups and feed a test diet.

11. William Colburn (wilcolburn@gmail.com)

BUFFERING EFFECTS OF EXERCISE AGAINST SOCIAL AND ENVIRONMENTAL STRESS IN THE FEMALE PRAIRIE VOLE

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Social bonds are essential to overall health and when disrupted various negative effects arise, such as depression, increased stress responses, and cardiovascular issues. Regular physical exercise has been shown to improve mental and physical health and could benefit individuals who lack social support. To assess this relationship, the socially monogamous prairie vole was used. We predict that isolated animals that exercise will display lower levels of depressive-like behavior in response to mild environmental stress compared to sedentary animals and exercising animals will display a lower stress response measured by the stress hormone corticosterone. Adult female prairie voles (n = 22) were socially isolated from a same-sex sibling for two weeks followed by an additional two weeks of isolation with chronic mild stress (CMS), a stress paradigm designed to mimic the hassles of everyday life. Half of the animals were allowed free access to running wheels during CMS while the remaining animals remained sedentary. Following CMS, all animals were exposed to a five minute forced swim test (FST) to assess depressive-like behaviors, and plasma was collected for circulating corticosterone analysis. Animals with running wheel access displayed lower levels of depressive behaviors during the FST and lower corticosterone levels compared to the sedentary condition. Our findings suggest exercise could be used as a potential intervention technique for individuals suffering from affective disorders and regular moderate exercise can provide a buffer against mild social and environmental stress. Further research is needed to assess the relationship between exercise levels and stress responses.

12. Claire Cole (coelecl@indiana.edu)

ASSOCIATIONS BETWEEN COURTSHIP BEHAVIOR, ESTROUS STATE, AND NEURAL ACTIVITY IN MICE

C. Cole, N. Jansing, J. Hanson, L. Hurley

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Context-dependent vocalization and reception of vocalizations has been a topic of noteworthy discussion, especially in laboratory mice as they are excellent models for communication disorders. Past studies have covered a wide range of topics involving both audible and ultrasonic vocalization and their relationship to contexts such as male-male, male-female and pup interactions. Despite these advances there is a surprising lack of information describing the relationships between courtship behaviors, hormone cycles, and neural activity in auditory centers of the brain. In this study the vocalizations and behaviors of female mice were recorded during exposure to three separate conditions; no interactions or auditory stimuli, one hour audio recording of male-female interactions, and one hour of male interaction. The female mice were assessed for estrous phase on the day of experimentation. Post-exposure, c-fos staining of in the inferior colliculus (IC) - an auditory midbrain region where some cells are selective for vocalizations - allowed for visualization of neural activity. Results show that females that produced more audible vocalizations during interactions had fewer c-fos positive neurons. Additionally, auditory stimuli by itself did not produce the same effect in the IC of females that listened to playbacks, suggesting that other factors during socialization influence neural activity in the IC. Finally increased durations of mounting behavior were observed when females were in the estrous phase. Additional data may bring new insights on the relationship between ultrasonic vocalization and other courtship behaviors and the effect they have on processing in the IC.

13. Udita Datta (udatta@bgsu.edu)

DEMONSTRATION OF AN OPERANT-CONDITIONING, SELF-ADMINISTRATION PARADIGM IN CRAYFISH, ORCONECTES RUSTICUS

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Natural reward circuits are fundamental to the ability to form associations in learning and are the essential generator of all forms of motivated behavior. Drugs of abuse are able to artificially trigger both the circuitry for reward and the incentive labeling of surrounding cues, in taxa ranging from fruit flies to humans. Recent work has established crayfish as a valid model for the study of addiction with confirmed vulnerabilities to human drugs of abuse, including demonstrations of sensitization, withdrawal, reinstatement, and drug reward in conditioned place preference paradigms. The present study aimed to develop measures of drug reward using an operant paradigm. Measures of reward strength were obtained using a spatially contingent task, where the animal needed to enter a specific substrate in order to earn a bolus of drug. Yoked controls received drug reward in a non-contingent fashion to estimate the magnitude of unconditioned effects. Enhanced operant behaviors were observed after 60 minutes providing a direct measure of reward strength and the time course of reward conditioning. With modularly organized and experimentally accessible nervous systems, the study of neural causation of behavior in crayfish provides a unique, comparative perspective on the nature of reward and the phylogenetically conserved vulnerabilities to addictive plant alkaloids.

14. Zita Erbowor-Becksn (zerboworb@indiana.edu)

DETERMINING EFFECT OF SEROTONIN ON INFERIOR COLLICULUS DURING SOCIAL INTERACTION

Z. Erbowor-Becksen, J. Hanson, L. Hurley

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The mammalian auditory system is often times stimulated by vocalizations during social interactions. The presence of neuromodulators can regulate the processing of these vocalizations. Serotonin is one neuromodulator that changes neural response by either inhibiting or increasing the firing of the neurons. Serotonin has many wide scale effects on the brain, specifically the inferior colliculus (IC), which is a region in the brain that processes auditory information. Though it is known that serotonin generally affects the firing of neurons, it is not known exactly how the IC is affected by serotonin during social behavior. To determine how
serotonin affects processing in the IC during social interaction, female mice were given three different drugs: saline, p-chlorophenylalanine (pCPA), and fenfluramine. The drug pCPA depletes serotonin levels, thus decreases serotonin levels while fenfluramine is a drug that causes serotonin to be released, thus increasing serotonin levels. Female mice were given either drug treatment, and then they were exposed to either silence, a playback of a social interaction, or a male mouse. During silence, playback and social stimulation, neural activity in the IC was influenced by fenfluramine. However, there was no significant difference between neural activity for pCPA and saline during silence, playback, and social stimulation. The results of this study make it possible to understand the role of serotonin regulation in auditory processing in mammals in general in the presence of social stimulation.

15. Caitlyn Finton (cjfinton@indiana.edu)

SQUEAKY, CREAKY, AND FREAKY: VARIATION IN FEMALE MOUSE SQUEAKS DURING COURTSHIP

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Vocal communication is used by many animals during courtship, including mammals. During courtship encounters of mice, males emit ultrasonic vocalizations and females typically emit squeaks. While ultrasonic vocalizations are known to be context dependent, less is known about female calls and how they relate to behavioral context. Female squeaks are typically structured as stacks of harmonic frequencies (“modal”); however, occasionally some calls include “nonlinearities” (NLs), consisting of a brief doubling of harmonics or noisy segments. NLs are a common feature of many mammalian vocalizations, yet their function remains unclear. The purpose of this pilot study was to describe the variation in female squeaks with regards to NLs and investigate the behavioral context during which squeaks with and without NLs occur. Encounters between female and male mice were recorded using a video camera and a microphone. Spectrographic analysis was used to measure number and duration of squeaks, as well as percent nonlinearity per call. We also measured male non-vocal behaviors, including investigation and mounting. On average, 31.5 ± 1.4% of female squeaks contained NLs. Calls including NLs had a longer duration than modal calls. Use of NLs varied over the course of encounters, with an increased percent of NLs per call during male mounting in some interactions. This suggests that the overall linearity of squeaks is sensitive to behavioral context. Future work will further characterize female squeaks and investigate the extent to which NLs convey information about female behavioral state.

16. Emma Fullerton (eiffkb@mail.missouri.edu)

UNDERSTANDING THE ROLE OF SIGMA RECEPTORS IN THE BEHAVIORAL EFFECTS OF COCAINE

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Previous experiments have shown that sigma receptor ligands alter cocaine-induced behaviors in rodents, and this work may yield insight into the biological basis of cocaine addiction for humans. This project examined sigma receptors with YZ-067 (N-phenylpropyl-N’-(4-methoxyphenethyl)piperazine), a ligand that blocks cocaine-induced hyperactivity in mice. The conditioned-rewarding properties of YZ-067 and cocaine were measured in conditioned place preference (CPP) where drug was paired with a distinct context and saline was paired with another context. Preference was defined as an increase in time spent in the drug-paired over the saline-paired context. YZ-067’s impact on motor skill was assessed via rotarod where mice were acclimated to the rod for three consecutive days and were then challenged with YZ-067. Anxiety-like behaviors induced by YZ-067 were determined by measuring preference for the open closed arms of an elevated zero maze after ligand injection. In the CPP assay, a high dose of YZ-067 enhanced the induction of cocaine CPP; however it did not affect the expression of cocaine CPP. YZ-067 failed to produce a change in motor skill or anxiety-like behavior. Overall, these data indicate that YZ-067 and the sigma receptors probed by this ligand play a role in the initiation of the development of the conditioned-rewarding properties of cocaine. These findings suggest
that sigma receptors may be an important target for pharmacotherapies against the development of cocaine addiction in humans.

17. Molly Goodfellow (goodfellow.10@osu.edu)

**IMPAIRED PAVLOVIAN CONDITIONING AND ALTERED FOREBRAIN N-METHYL-D-ASPARTATE RECEPTOR SUBUNIT COMPOSITION IN A RAT MODEL OF FETAL ALCOHOL SPECTRUM DISORDER**

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The present study employs a fetal alcohol spectrum disorder (FASD) rat model in which binge-like ethanol is administered via intragastric intubation over postnatal days (PD) 4-9, a period comparable to the human third trimester. The forebrain is susceptible to a variety of ethanol-induced neurotoxic effects, including diminished N-methyl-D-aspartate receptor (NMDAR)-dependent plasticity. Trace fear conditioning (TFC), which depends specifically on NR2B subunit-containing NMDARs, is impaired in adult ethanol-exposed (5E; 5 g/kg/day) rats relative to sham-intubated (SI) controls (Dupont et al., in press). We hypothesize that altered NMDAR subunit composition in 5E rats contributes to impaired consolidation of NMDAR-dependent TFC. Adult (~PD70) male and female rats were submitted to TFC, consisting of 10 trials of a 15 s tone followed 30 s later by a 1 s, 0.8 mA footshock. Preliminary results indicate 5E rats express significantly less conditioned fear to the tone and context at test than controls. Interestingly, 5E males are more impaired in tone freezing whereas 5E females in proestrus, a period of peak estrogen levels, appear to be more impaired in context freezing. Immunoblotting is being used to investigate NMDAR subunit composition (NR1, NR2A, NR2B) in tissue from the medial prefrontal cortex and dorsal and ventral hippocampus of TFC rats as well as synaptic and extrasynaptic fractions from experimentally naïve SI and 5E rats. We propose to relate sex-specific changes in NMDAR composition in 5E rats to impaired TFC memory consolidation.

18. Brittney Graham (grahamb4@maimioh.edu)

**ARE BEHAVIORAL INTERACTIONS BETWEEN MALE AND FEMALE PRAIRIE VOLES CORRELATED WITH MALE AVPR1A GENOTYPE?**

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In socially monogamous species, male behaviors such as paternal care can have a substantial affect on a pair’s reproductive success. Since male behavior varies among individuals, a female in a socially monogamous species might be expected to use phenotypic cues correlated with male behaviors, such as fidelity and paternal care, when selecting a social partner in order to maximize her own reproductive success. Prairie voles display varying levels of social monogamy in nature. In males, variation in microsatellite DNA length in the regulatory region of the avpr1a gene encoding the vasopressin 1a receptor (V1aR) underlies differences in V1aR neural expression and is related to significant differences in sociosexual behavior. Laboratory studies demonstrated that males possessing longer avpr1a microsatellite alleles spend more time with their female social partner and provide more paternal care relative to males with shorter avpr1a microsatellite alleles. In laboratory preference trials females displayed significant social and sexual preferences for males that possessed longer avpr1a microsatellite alleles and shorter avpr1a microsatellite alleles, which is consistent with the hypothesis that females are using phenotypic cues whose expression is related to a male's avpr1a microsatellite genotype to discriminate among potential mates. Analysis of behavioral interactions between males and females in these preference trials indicates that males with longer avpr1a microsatellite alleles spent significantly more time engaged in sniffing females, relative to males with shorter avpr1a microsatellite alleles. Male avpr1a genotype was not related to the amount of side-to-side or total contact with females. Thus, sniffing behavior might contribute to female discrimination among males.

19. Jeff Hansen (jhansen5@nd.edu)
THE EFFECT OF BABOON HYBRIDITY ON PARASITE RESISTANCE MECHANISMS

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The effect of hybridity upon the fitness of individuals varies across species. For instance, the concept of hybrid vigor proposes that hybrid organisms benefit from outbreeding. Alternatively, hybridization may be costly if it disrupts locally-adapted gene complexes or leads to super-optimal MHC diversity that results in T-cell depletion. The baboon population in the Amboseli basin lies in a natural hybrid zone between two sub-species: yellow baboons (Papio cynocephalus) and Anubis baboons (Papio cynocephalus Anubis). Using genetic hybrid data and measures of gastrointestinal parasitism, this project hopes to explain the effect of hybridity on patterns of parasitism. We predicted that, if parasite diversity is unique to each sub-species and environment, yellow baboons may have better resistance to parasites unique to the Amboseli ecosystem and consequently have a lower parasite load compared to immigrant Anubis baboons and hybrids. In support, preliminary results suggest that in females, both increased hybridity and increased Anubis ancestry correlates with increased burden of the most prevalent and costly parasite, Trichuris trichiura. Conversely, in females, greater Anubis ancestry correlates with a decreased burden of Abbreviata sp., another relatively common and costly parasite. This study is among the first to explore the effects of hybridity on parasitism in a wild primate setting and results will have implications for understanding the selective forces that may maintain species boundaries.

20. Nicholas Jackson (npjkd2@mail.missouri.edu)

METHAMPHETAMINE-INDUCED HYPERACTIVITY AND REINFORCEMENT LEARNING IN RATS SELECTIVELY-BRED FOR HIGH- AND LOW- VOLUNTARY RUNNING

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Drug abuse and dependence are significant, yet preventable, public health concerns world-wide. There are few effective pharmacotherapies and treatment strategies available to help people struggling with drug abuse, especially with respect to the psychostimulants cocaine and methamphetamine. Previous research has outlined the benefits of exercise on substance abuse. The present research compares the behavioral profile of two lines of Wistar rats selectively-bred for high- and low-voluntary wheel running to a line of outbred counterparts, in a model of acute methamphetamine reactivity and in reinforcement learning. In a locomotor activity experiment, groups of male and female rats were acclimated to automated activity monitors for two days. On the third day rats received an injection (i.p.) of methamphetamine or saline and locomotor activity was measured. In the reinforcement learning experiment, groups of female rats were trained to respond on a fixed ratio schedule for food reinforcement. Responding under progressive ratio and extinction was then determined. The use of selective breeding to generate divergent lines is a valuable approach for the study of genotype-phenotype interactions. The current research project is an early and preliminary step toward a larger research goal to investigate underlying mechanisms of behavioral motivation believed to be common between food, drugs, and exercise (e.g., dopamine in the nucleus accumbens).

21. Jessica Judd (jmjkc2@mail.missouri.edu)

ROLE OF SIGMA RECEPTORS IN COCAINE CONDITIONED PLACE PREFERENCE

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Conditioned place preference (CPP) is a model of how environmental cues influence drug use and involves
pairing a drug (cocaine) with a neutral stimulus. After conditioning, mice display a preference for the area paired with cocaine. Cocaine's affinity for \( \sigma_1 \) and \( \sigma_2 \) sigma receptors contributes to its conditioned-rewarding effects. Sigma receptor antagonists have been shown to reduce or prevent cocaine-induced CPP. Here, the ability of the sigma receptor ligand PD-144418 to affect cocaine-induced CPP was determined. PD-144418 has high affinity and is very selective for the \( \sigma_1 \) over the \( \sigma_2 \) sigma receptor subtype. PD-144418's ability to produce CPP and to influence the induction and expression of cocaine-induced CPP was determined in mice. Rotarod and zero-maze procedures were conducted to determine PD-144418's effect on learned motor skill and influence on anxiety-like behavior. The results showed that a high dose of PD-144418 enhanced the induction of cocaine CPP; however, PD-144418 showed no effect in the other measures. Overall, these results indicate a role for the \( \sigma_1 \) sigma receptor in the conditioned-rewarding properties of cocaine and that PD-144418 may behave as a \( \sigma_1 \) receptor agonist. These results further reinforce the theory that sigma receptors are important in the behavioral effects of cocaine.

22. Jeremy Karnowski (jkarnows@cogsci.ucsd.edu)

VOCALIZATIONS IN SOCIAL INTERACTIONS AMONG CAPTIVE DOLPHINS

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In order to understand the role of vocalization in dolphin social interactions, we need to know which animals are engaged with which other animals, what activity they are engaged in, and which animals are vocalizing. In this poster we describe our efforts to address the linked problems of identifying individual animals and identifying which animal produced which sounds. Solving these problems is a necessary foundation for understanding the role of vocalizations in dolphin social interactions. We first address how we are developing tools to facilitate the work of human observers who document the locations of dolphins. Secondly, we show the development of computational techniques to automatically extract a particular vocalization type, the whistle, from our huge audio corpus. Finally, we explore computational methods to cluster one whistle type into multiple subtypes, as previous research suggests that vocalizer identity might be linked to whistle variation. We evaluate our whistle detector and present the first known results of attempting to cluster vocalizer by whistle subtype. We conclude by discussing future improvements to our methods, ways to use our new massive dataset of whistles, and how we can use these vocalizations to inform our understanding of dolphin behavior and communication.

23. Sarah Keesom (skeesom@umail.iu.edu)

SEASONAL VARIATION AND SEX DIFFERENCES IN SIBERIAN HAMSTER VOCALIZATIONS

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Social behaviors vary on a seasonal basis; communication may also change to accommodate behavioral needs. For example, use of song by passerine birds changes across season in accordance with reproductive state. Less is known about seasonal variation in vocal communication by mammals. The Siberian hamster (Phodopus sungorus) is a potential model to study seasonal vocalizations, because they exhibit seasonal changes in physiology and behavior, and they vocalize during social encounters. Here, we studied vocal behavior during same-sex interactions of male and female hamsters. This study had three aims: 1) to characterize Siberian hamster vocalizations, 2) to assess how these vocalizations vary with sex and season, and 3) to investigate how vocalizations relate to behavioral context. Males and females were housed in long "summer" days or short "winter" days; audio and video were recorded from 5-minute encounters. We characterized two major vocal classes: "ultrasonic vocalizations" (USVs) and "broadband calls" (BBCs), with subtypes of each. Both male and female hamsters produced an array of USVs and BBCs across seasons. While USV total number did not vary, use of particular USV subtypes varied with season, sex, or both,
suggesting that sex and season influence a potential vocal signal of hamsters. BBCs were related to seasonal aggression; more BBCs were emitted during encounters between non-reproductive animals. As well, BBCs corresponded with aggression across time. This work demonstrates that the Siberian hamster can be used as a mammalian model for studying the converging influences of sex, season, and context on communication.

24. Diana Klimas (dklimas@bgsu.edu)

ASSESSMENT OF RELIABILITY OF SPATIAL INFORMATION BY PIGEONS

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Information about food sources may differ both in the coordinates of the most likely site of reward and on the probability distribution of success around such sites. During learning, such information may be acquired through the distribution of reward locations. We explored this problem by training homing pigeons on a spatial task where two sources of reward, cued by differently colored lights, delivered food at the periphery of a circular arena. On single-cue trials, the location of reward was centered on the position of the light but had a symmetric spread around such location, according to a cue-specific probability distribution. The distributions associated with each cue differed in kurtosis (i.e. one probability was normally distributed and the other probability was flattened), and hence on the reliability of spatial information. On single-cue trials the pigeons similarly preferred the central value of each distribution, but choices were made to all candidate goal locations. However, when given a binary choice during probe trials, they preferred the more kurtotic, and hence more reliable of the two cues. Our results are compatible with decisions taking place by cross censorship between random samples from the memory distributions. Functionally this makes pigeons able to assess reliability as well as central value of probabilistic distributions of reward.

25. Qingling Li (li877@purdue.edu)

DIFFERENCE BETWEEN MALE AND FEMALE DIRECTED SONG IN BROWN-HEADED COWBIRDS (MOLOTHRUS ATER)

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Male brown-headed cowbirds (Molothrus ater) are a good example of songbird that evolved songs via inter- and intrasexual selection; indeed, song can signal multiple pieces of information, including courtship and aggressive intentions, and may be an indication of a male's overall quality. A previous study suggests that female cowbirds prefer males with a large repertoire, but it assumed that there is no difference between female and male directed songs within this species. However, Morton's Motivational Structural Rules hypothesis suggests that physical structure of sound has a relationship with the motivation underlying its use. Therefore, we predicted male cowbirds sing higher frequency and more tonal sounds when directed towards a female, but lower frequency and wider bandwidth when directed to a male. Additionally, we also predicted males should sing at a higher rate towards female than male conspecifics. Using cross-correlation analysis, we found that pairs of songs are more dissimilar if they are directed to different sexes compared to the same sex. Using Sound Analysis Pro, we found these differences are caused in part by significant differences in fundamental frequency and entropy in male versus female songs and that our results supported the hypothesis. Moreover, we found that males sing at higher rates to females compared to males. These findings suggest that in highly social species, male birds may modify their songs to direct their signals to a specific receiver; the ability of a male to do this may related to his overall quality as a mate.

26. Jeffrey Lojewski (jalojewski@eiu.edu)

THE ROLE OF LANDMARKS IN TERRITORY MAINTENANCE BY THE BLACK SADDLEBAGS DRAGONFLY, TRAMEA LACERATA

Territoriality can reduce competition for resources, but the time and energy required for defense make it costly. Therefore any behavior that reduces costs may increase the net benefit of territoriality. Some species align their territory boundaries with conspicuous landmarks that may reduce defense costs. Dragonflies, including black saddlebags (Tramea lacerata), defend territories at breeding sites, keeping rival males away to allow themselves access to females. Anecdotal evidence in a few species of dragonflies has suggested that they may align their territories with clumps of vegetation, but no one has demonstrated experimentally whether dragonflies use landmarks as territory boundaries. Using focal sampling, we observed patrolling male black saddlebags and recorded the locations of turns at their territory boundary. To investigate defense costs, we recorded whether the turn was spontaneous or due to an interaction with another dragonfly. We had three treatments that occurred on separate days: constraining landmarks (consisting of a rectangular physical barrier), non-constraining landmarks (consisting of the barrier's frame, providing a conspicuous feature without restricting movement), and a control without landmarks. When a landmark was present individuals placed their boundary at the landmark far more often than any other location. Individuals that used landmarks had a significantly narrower range of turn locations than those that did not. Unlike other studies the use of a landmark did not seem to reduce defense costs, and interestingly not all individuals used landmarks when they were provided. These patterns suggest unique properties of dragonfly territoriality in the maintenance of territorial boundaries.

27. Tierney K. Lorenz (lorentz@indiana.edu)

ALLOPARENTING MAY MODERATE DEVELOPMENT OF HOT FLASHES DURING MENOPAUSAL TRANSITION

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There are broad differences across cultures in the experience of vasomotor symptoms (hot flashes, night sweats) in peri-menopausal women. Women in cultures where regular contact with young children (e.g., grandchildren) are common report significantly fewer and less severe hot flashes than women in cultures where older women spend less time around young children (for review see Freeman & Sherif, 2007). Are these differences related to a third variable (e.g., differences in diet, climate, or cultural norms in symptom reporting), or due specifically to the presence of young children? We examined this question in 94 healthy women undergoing prophylactic bilateral oophorectomy (removal of both ovaries to reduce the risk of gynecologic cancers). Participants provided demographic information at baseline, including pre-surgical menopausal status and number of children <13 years old living at home. They were surveyed on menopausal symptoms 2 weeks prior to surgery, and then 2 months, 6 months, and one year following surgery. Women who were premenopausal at the time of surgery experienced a significant increase in vasomotor symptoms after surgical removal of their ovaries. However, in this group, participants with young children at home reported significantly fewer vasomotor symptoms than women who did not have young children. Women who were already menopausal at the time of surgery reported a decrease in vasomotor symptoms over time, particularly if they had young children at home. These findings suggest that interactions with young children may mitigate hot flashes, particularly the initial experience of hot flashes in women entering menopause.

28. Radhika Makecha (radhika.makecha@gmail.com)

THE EXAMINATION BEHAVIORAL CHANGES IN A SCHMIDT'S GUENON MONKEY (CERCOPITHECUS ASCANIUS SCHMIDTI) AFTER VISUAL EXPOSURE TO SUB-SAHARAN SYKES MONKEYS (CERCOPITHECUS ALBOGULARIS)
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Studies on the behavior of the genus, Cercopithecus, are scarce (Baranga, 2004; Buxton, 1952; Cords, 1990; Lambert, 2001; Teelen, 2007). An opportunity to study the behavioral changes of a male Schmidt's Guenon monkey (Cercopithecus ascanius schmidti) arose at an enclosed facility in The Bahamas. The study was aimed at 1) adding to the existing literature on the behavior of Cercopithecus and 2) investigating any changes in behavior (preferably positive) that resulted from housing of a Schmidt's Guenon monkey alone versus in a social setting. Baseline behavior was collected on the Schmidt's Guenon monkey while living alone at the enclosed facility and again after he was moved next to a group of three Sub-Saharan Sykes monkeys (Cercopithecus albogularis), two females and one male, in a shared divided enclosure. A combination of instantaneous focal sampling, used to look at changes in general behaviors, as well as all-occurrence focal sampling, used to look at changes in behavioral events, were utilized to examine behavioral changes in the Schmidt's Guenon monkey (Altmann, 1974). The findings will be presented, as well as the implications of the study and suggested future directions on behavioral research of Cercopithecus.

29. Radhika Makecha (radhika.makecha@gmail.com)

CHANGES IN THE BEHAVIOR OF A GROUP OF ENCLOSED ASIAN ELEPHANTS AS A RESULT OF THE DEATH OF THE MATRIARCH AND A SHIFT IN SOCIAL HIERARCHY

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Wild Asian elephants (Elephas maximus) are a social species that live together in families consisting of several related adults, their calves (both male and female), and a matriarch (Buss, 1961; Poole, 1994; Schulte, 2000; Spinate, 1994; Sukumar, 1994). In wild animal parks, female Asian elephants tend to be housed together, but these "families" are typically smaller, have a lower degree of relatedness, and rarely consist of calves, all of which are factors that may lead to a decrease in the amount of social interactions seen between group members when compared to wild elephant families. However, in spite of the differences that may exist between wild and captive Asian elephants, both populations exhibit much of the same social behavior (Schulte, 2000). For example, in some cases, females are known to preferentially form affiliative associations with certain other females in their groups (Garai, 1992). Additionally, dominance hierarchies are still observed in captive groups housed in wild animal parks. Long-term data collection on the behaviors of Asian elephants housed at Busch Gardens in Tampa, Florida, has been taking place since 2006. At the start of these observations, up until mid-2008, the group consisted of six Asian elephants, including the matriarch. In mid-2008, the matriarch passed away, leaving us with an opportunity to study the behavioral changes of the group of elephants before versus after the death of a matriarch. Findings will be presented, as well as the implications of the study.

30. Janel Ortiz (ortizjanel@gmail.com)

URBAN/SUBURBAN HABITAT USE BY A NATIVE AND INVASIVE TREE SQUIRREL IN SOUTHERN CALIFORNIA

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The Eastern Fox Squirrel has been introduced to Los Angeles and other areas within California. Over time, the fox squirrel has expanded its geographic range and has displaced the native Western Gray Squirrel in many urban/suburban habitats. Possible reasons for displacement could be differences in habitat, space, and/or resource use by each species. Habitat use is defined as the way an animal uses the habitat's physical and biological resources through its environmental components and the animal's behavior. I tested gray and fox squirrels in their willingness to approach novel food sources and exploit them away from the protective refuge of trees, thereby utilizing more space and resources but increasing predation risk. Daily activity of both species was documented to determine similarities and differences in their use of time within the habitat during the
summer and winter seasons. A significant difference in approaches to novel food items was found between the two species. No differences were found in daily activity during the summer and winter seasons between species. Shifts in activity occurred as summer transitioned to winter. Other portions of this study include food preferences and monitoring reproductive activity. These results provide information on the coexistence of gray and fox squirrels and potential reasons for gray squirrel displacement.

31. Lauren Rudolph (lamarudo@indiana.edu)

SATELLITE CELLS IN THE TARGET MUSCLE ARE NOT CRITICAL FOR ESTROGEN-DEPENDENT SNB MOTONEURON DENDRITE GROWTH DURING EARLY DEVELOPMENT

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The spinal cord of rats contains the sexually dimorphic, steroid-sensitive spinal nucleus of the bulbocavernosus (SNB) that innervates the penile musculature, controlling erections and ejaculations. SNB dendrite growth requires gonadal hormones. We have previously demonstrated that estrogen-dependent dendrite growth is mediated by estrogen receptors (ERs) in the target musculature. Estrogenic support of SNB dendrite growth is limited to the early postnatal period, and dependent on the transient expression of ERα in cells located outside of muscle fibers (“extra-muscle fiber cells”) in the SNB target musculature. The identity of these extra-muscle fiber cells is unknown, but could include satellite cells, fibroblasts, adipocytes, or terminal Schwann cells. This study began to attempt to identify these ERα expressing cells. Satellite cells are important in muscle development, regulating trophic factor expression, and maintaining muscle progenitor cells; they also express androgen receptors in the SNB target muscle. Because these cells regulate neuromuscular development and are gonadal steroid targets, we assessed whether satellite cells in the developing SNB target muscle express ERα. We performed immunohistochemistry for PAX7, a satellite cell marker, and ERα in the SNB target muscle at P14, when extra-muscle fiber ERα is highest. Confocal microscopy was used to identify potential colocalization. We assessed an average of 145.6 satellite cells from an average of 4.6 fields through the SNB target muscle from each of 5 male rats. No evidence of PAX7-ERα colocalization was observed, ruling out satellite cells as the critical site for estrogen-dependent dendrogenesis.

32. Ryan Seddon (rseddon@sycamores.indstate.edu)

DO MELANIZATION AND TESTOSTERONE PLAY A ROLE IN AGGRESSION FOR THE LIZARD, SCELOPORUS OCCIDENTALIS

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A growing area of behavioral ecology examines how mechanisms underlying production of pigments can affect traits other than body coloration. Melanin, and molecules that regulate melanin, can directly and indirectly affect other phenotypic traits, such as aggression or physiology. These associations have been studied mainly in birds and mammals, but less so in reptiles. As a first step in examining an elevational gradient in melanization, we studied adult males in a high- and low-elevation population of the western fence lizard, Sceloporus occidentalis during the breeding season (June 2013) along the Merced River and in Yosemite National Park. This previously-characterized elevational gradient exhibits increasingly darker-bodied and larger adults at higher elevations. To compare the two populations, we measured degrees of melanization between the two populations to quantify differences in coloration. By calculating melanization in multiple ways, we found that the higher elevation population was significantly darker than the lower elevation population. Also, we assessed the agonistic behaviors of males in response to standardized staged territorial intrusions (STIs). Principle-components analysis on behavioral responses to the STIs revealed that darker (higher-elevation) males were more aggressive than males in the lighter population. Melanization and aggression was correlated between the two populations, but not within. We also tested whether there was a testosterone difference associated with elevation and determined no significant difference between the two populations. We are assaying plasma
corticosterone, and will determine if population differences in the traits examined are associated with differences in stress reactivity.

33. Delia Shelton (delsshel@indiana.edu)

**SPATIAL STRUCTURE OF ZEBRAFISH SHOALS IS INFLUENCED MORE BY THE PHYSICAL ENVIRONMENT THAN THE SOCIAL ENVIRONMENT**

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The formations made by gregarious animals can range from loose aggregates to highly synchronized and ordered structures. For very large, coordinated, groups, both physical and social environments are important for determining the physical arrangement of individuals in the group. Here we tested whether physical and social factors are also important in determining the structure of small, loosely coordinated groups of zebrafish. We found that even though our fish were not crowded and did not use most of the available space, the distance between individual fish was explained primarily by the amount of available space (i.e., density). Zebrafish in a larger space spread out more and the total dimensions of the shoal were an additive function also of group size. We, however, did not find any impact of social or physical environment on the orientation of individual fish or shoal. Thus, both physical and social factors were important for shoal spatial arrangements, but not individual orientation and shoal alignment.

34. Conor Smith (cmsmit18@neiu.edu)

**TOO COOL FOR SCHOOL**

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Purpose: The purpose of this study is to examine the effects of ostracism on social behavior in zebrafish. It is hypothesized that ostracized zebrafish will not participate in common prosocial behaviors, such as schooling, while in groups with control fish. Methods: Adult male and female zebrafish were tagged and ostracized for two weeks, after which they were placed in an observation tank with four control fish for a five minute acclimation period, followed by a two minute recording period. Video recordings and timed photographs were taken of zebrafish and control fish, in the observation tank. Videos were analyzed with ImageJ (NIH) using the Manual Tracking plugin to measure distance, angular heading, and nearest neighbor distance. Results: While there was no difference in the distance of treated and control fish (75.0±2.5 cm, 73.1±2.6 cm, respectively), ostracized zebrafish did not participate in prosocial behaviors among controls. Both groups swam ~74 cm during a 30 second interval, however, the angular heading for treated fish was significantly different from the control (t(59) = 1.66, p < .04). Consistently, treated fish favored swimming in areas of the observation tank that were not preferred by the controls. Conclusions: Our findings show that ostracized zebrafish did not participate in prosocial behavior. The findings of this study can be applied to research pertaining the effects of ostracism on human behavior. Things to consider for future research are how long the effects of ostracism last, and if there are any identifiable neural changes.

35. Amanda Smith (arsmith@ilstu.edu)

**SUB-SECOND MEASUREMENT OF ELECTRICALLY-EVOKED DOPAMINE RELEASE IN THE EUROPEAN STARLING**

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In the striatum and nucleus accumbens, dopamine is released in response to novel or otherwise salient sensory stimuli. Recently, it has been hypothesized that this dopamine may encode the "incentive salience", or incentive value, of incoming information. To date, dopamine release in response to drug or food presentation has been fairly well characterized, but the role of dopamine in processing complex, naturally salient stimuli, such as social or sexual signals, remains largely unexplored. The clarity and distinct ecological context of social signaling in songbirds make them a desirable model for investigating this relationship between neural signaling and social signal perception. To address this, we have recently implemented fast-scan cyclic voltammetry (FSCV), a powerful technique able to measure sub-second changes in electroactive chemicals, to quantify changes in dopamine concentration in the striatum of a songbird, the European starling. We inserted carbon fiber microelectrodes into the striatum and nucleus accumbens of deeply anesthetized starlings, and electrically evoked dopamine overflow by stimulating the ventral tegmental area, a dopamine producing region of the brain. This represents, to our knowledge, the first in vivo use of this technique in a non-mammalian vertebrate. Here we describe the characteristics of in vivo dopamine release and uptake in the European starling, and make comparisons to the rat, a common mammalian model. This work is an important first step in establishing FSCV in a songbird system, thereby laying the groundwork for future studies investigating dopamine release during complex social stimuli.

36. Kamela Stamey (kstamey@bgsu.edu)

AGGRESSIVE DECISION-MAKING IN CICHLIDS

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Aggressive behavior stems from a variety of states, including hormonal and motivational status, genetic makeup, previous experience, and resource availability. Because biological fitness favors the differential use of behavioral strategies based on environmental variability, aggressive decision-making emerges as a critical component in optimizing fitness. Due to the costly nature of aggressive encounters, the use of informative assessment behaviors prior to physical confrontation decreases the likelihood of serious injury. African cichlids, well-known for their hyper-aggressive nature, are ideal models for exploring aggressive decision-making. Using a two-part experimental design, we characterized fighting strategies between same-sex pairs of Melanochromis auratus, a highly territorial Malawi cichlid, probing the intersexual and size-related differences that influence fighting tactics. Experiment 1 operated under the well-supported assumption that maximal aggression is expressed when body size asymmetry is small. We staged fights between sized-matched opponents and extracted behavioral measures indicative of aggressive and assessment tactics. Size-dependent strategies were observed: smaller fish exhibited tendencies toward assessment behaviors, while larger individuals preferred to engage in physical contact. Intersexual differences were also observed. Experiment 2 used modified mirror image stimulation methods to study how opponent size impacts aggressive decision-making. This novel approach uses mirrors with different surface curvature to query size-dependent aggressive responses. Individual fish perceived images of opponents that were of larger, smaller, or equal size. Both males and females displayed a surprising tendency to engage more frequently with larger opponents and utilized opponent size-dependent fighting tactics.

37. Jessica Thornton (jlthornton@eiu.edu)

FACTORS AFFECTING THE SPATIAL DISTRIBUTION OF OVIPOSITION SITES FOR TANDEM BLACK SADDLEBAGS DRAGONFLIES (TRAMEA LACERATA HAGAN)

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We studied oviposition behavior in the black saddlebags dragonfly (Tramea lacerata Hagen) at a pond to examine how they distributed oviposition locations and how these locations were affected by interactions with other individuals. We found that a male and female typically remain in tandem while traveling among potential
oviposition locations, pausing over different sites. For approximately one-half of these pauses, the male released the female and she would dip down to the water to lay eggs before resuming the tandem. Oviposition sites were typically away from the shoreline at the outer edge of the vegetation on the water's surface, and pauses that led to an oviposition were significantly closer to the outer edge of the vegetation than pauses that did not lead to oviposition. We also found that tandems distributed their oviposition locations widely around the pond, and interactions with other dragonflies (typically other T. lacerata) led to a larger distance between consecutive oviposition locations. Interestingly, for 10% of the tandems, the female became separated from the male and oviposited solitarily multiple times. For these solitary females, the female always oviposited and she spent significantly less time and traveled significantly less distance between successive oviposition sites. Our results indicate that while some aspects of oviposition behavior may be consistent between the male and female (e.g. the characteristics that make a site suitable), other aspects, such as the distribution of sites, may be a result of a differing benefits and costs for the two sexes, perhaps as a consequence of potential sperm competition.

38. Ruiyu Zeng (zeng23@purdue.edu)

FEMALE BROWN HEADED COWBIRDS PREFER MORE INTENSE FEMALE DIRECTED DISPLAYS

Department of Biological Sciences, Purdue University, West Lafayette, IN

In general, communication involves a sender (who produces the signal) and a receiver (who processes that signal). These communication signals are often multimodal in nature; for example, during courtship male brown-headed cowbirds (Molothrus ater) combine a visual wing-spread display with an acoustic song. Female cowbirds have been shown to prefer males with less intense visual displays (e.g. wingspread displays without a bow), as more intense displays are often used during aggressive encounters with other males. We tested the hypothesis that male cowbird signals are non-redundant by performing a playback study in which we paired different videos of males displaying at different intensity levels with songs of different potency levels. We predicted females would show significantly longer Copulatory Solicitation Displays (CSD) to videos with a high-potency song and low-intensity display. Overall, we found that females show significantly longer CSDs to videos with high-potency songs and high intensity displays; additionally, we found that females are significantly slower to display to videos with low-potency songs and low-intensity displays. Therefore, our results suggest that the male multimodal signal is, in fact, non-redundant but our prediction is not supported: females prefer high-intensity displays. We suggest a possible explanation for our finding is that female cowbirds from different cultures (Indiana vs California) may prefer different male visual displays; and perhaps male display intensity is positively correlated with overall male quality in Indiana cowbirds.

SATELLITE SYMPOSIUM ABSTRACTS

1. Kelly Ronald (kspratte@purdue.edu)

BEAUTY IN THE EAR OF THE BEHOLDER?: LINKING HEARING AND MATE-CHOICE IN ASONGBIRD

K. Ronald, E. Fernandez-Juricic, J. Lucas
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In general, communication involves a sender producing a signal and a receiver processing and responding to that signal after it has traveled through the environment. Song birds have been a model system for studying the evolution of communication signals as males use song to court females; females then evaluate males' song and make a mate-choice decision. We now know much about how males vary in their signaling, how the environment constrains the propagation of these signals, and we are beginning to build a foundation for understanding how receiver processes those signals. Nevertheless, the link between sensory processing and eventual mate-choice is still largely underdeveloped. We asked whether female auditory processing can help to
explain the variation we see in mate-choice in female brown headed cowbirds (Molothrus ater). Results will be discussed in the context of sexual selection theory and implications for the evolution of communication signals will be reviewed.

Symposium Schedule

2. Andrew Stoehr (astoehr@butler.edu)

COURTSHIP AND WING PATTERNS IN CABBAGE WHITE BUTTERFLIES

A. Stoehr, K. Hayes, E. Wojan
Department of Biological Sciences, Butler University, Indianapolis, IN

Conspicuous sexual dimorphism in colors and color patterns are usually hypothesized to be the result of sexual selection. However, sexual selection is not the only plausible explanation for sexual dimorphism so it is necessary to test the sexual selection hypothesis. Butterfly wing patterns are often sexually dimorphic but for a long time, lepidopterists assumed that butterfly visual acuity was insufficient to permit courtship decisions based on anything but the most conspicuous color and color pattern variations. Recent work has shown that butterflies can and do in fact sometimes make courtship and mating decisions based on more subtle wing pattern elements. The cabbage white butterfly is sexually dimorphic for both wing color hue (particularly the degree of white and UV reflectance) as well as wing spot patterning. Females typically have two black spots whereas males have one. While hue has been shown to influence courtship and mating decisions, it is still unclear whether the same is true for the spot patterns. We have attempted to test the hypothesis that spot number influences mating behaviors in wild and captive cabbage whites using manipulative experiments involving pinned specimens and electronic "robots". Our results, though suggestive of a role for spot number, are not conclusive.

Symposium Schedule

3. Tierney Lorenz (lorenzt@indiana.edu)

FUNCTIONAL IMMUNITY ACROSS THE MENSTRUAL CYCLE

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Several studies have documented changes in immune system parameters across the menstrual cycle in healthy women. These changes are hypothesized to reflect the balance between reproduction and conception: that is, immune system downregulation around ovulation reflects the need to avoid accidentally attacking sperm or the blastocyst before a protective placenta can be formed. However, there has been little work showing if such changes reflect functional immunity - that is, how well the immune system works to prevent infection. We examined functional immunity across the menstrual cycle in 14 women (8 sexually active, 6 sexually abstinent). We took serum samples at menstruation and ovulation (day 1 and approximately day 14 of participant's menstrual cycle; ovulatory LH surge was confirmed with urine test). These samples were used for bacteria killing assays. A known concentration of bacteria (E.coli) was allowed to incubate with diluted serum on agar plates, and compared to a control plate incubated with bacteria only. Women who were sexually abstinent had significantly lower functional immunity (lower bacterial killing) at ovulation than at menstruation (t(5)= 3.65, p = .01). In contrast, women who were sexually active showed little change in functional immunity across the menstrual cycle (t(7)= 1.07, p = .32). It is possible that sexual activity may moderate immune system fluctuations to protect potential mothers from infection during fertile periods.

Symposium Schedule

4. Jeremy Heath (jjheath@ncsu.edu)
CONFLICT BETWEEN SEXUAL AND NATURAL SELECTION: THE DUAL ROLE OF MALE MOTH COURTSHIP PHEROMONES

J.J. Heath
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Changes in female pheromone quality are supposed to be under strong stabilizing selection because of the negative fitness consequences on non-responding males or off-blend producing females. This theorized stabilizing selection poses a major problem to understanding how divergence occurs in species that rely heavily on intraspecific pheromone communication. Others have found and we have confirmed that some of the female pheromone components and precursors are also produced in the genital hairpencils of male Heliothis virescens, but other more volatile, diet-derived, and sequestered compounds have increased physiological activity and the potential to influence progeny fitness directly when transferred to females as nuptial gifts. In addition, selection lines show that male hairpencils lack a specific female component even though selection was imposed only on females. This sets up a potential evolutionary dilemma for females that may ultimately maintain diversity in female pheromone-blend quality and relax the supposed strong stabilizing selection that may allow divergence under the right selective forces. On the one hand, females may choose males which are more likely to contain the genes to create attractive daughters or they may choose males which contain nuptial gifts that will increase the fitness of all their progeny. Here we provide chemical, physiological, and behavioural evidence in support of this hypothesis.

Symposium Schedule

5. Invited Speaker: Justin Garcia (jusgarc@indiana.edu)

MODERN HUMAN DEVELOPMENT, SOCIOSEXUALITY, AND REGULATION OF REPRODUCTIVE STRATEGIES

J.R. Garcia
Department of Gender Studies & Kinsey Institute, Indiana University, Bloomington, IN

Human evolutionary behavioral scientists have shown, with somewhat mixed results, that adverse early life experiences can result in the development of an accelerate life history strategy - including onset of reproductive maturation and sexual behavior. The impact of family and environment on reproductive and sexual strategies has been framed as a predictive adaptive response. However whether this response is external (an adaptive "forecast" of future conditions) or internal (a result of early somatic state and subsequent age-related health declines) is still debated. Also still debated is what factors in particular, and at what time in the early life course, will result in predicative adaptive responses during early development. In this talk, I will review the current state of the literature as it applies to humans, and highlight some of our own studies using samples as diverse as the original Kinsey survey (collected in the U.S. between 1938 and 1963) to contemporary college students (collected since 2010) engaging in sexual activity across a continuum of romantic commitments.

Symposium Schedule

6. Muchu Zhou (zho1@illinois.edu)

ASYMMETRIC COLOR-BASED SPECIES DISCRIMINATION IN ORANGETHROAT DARTERS

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Social interaction requires that relevant sensory information is effectively collected, classified, and distributed to the motor areas that initiate an appropriate behavioral response. Vocal exchanges, in particular, depend on linking auditory processing to an appropriate motor expression. Because of its role in integrating sensory
information for the purpose of action selection, the amygdala has been implicated in social behavior in many vertebrate species. Here, we describe circuits that link hearing and utterance, and examine the role of the central amygdala (CeA) and bed nucleus of the stria terminalis (BNST) in the sensorimotor integration underlying vocal communication in the African clawed-frog, *Xenopus laevis*. Evidence from tracing with fluorescent dextran amines identifies the CeA as a target for ascending auditory information from the central thalamus and as a major afferent to the vocal pattern generator of the hindbrain. In the isolated (*ex vivo*) brain, electrical stimulation of the CeA, or the neighboring BNST, initiates bouts of fictive calling. *In vivo*, lesioning the CeA of males eliminates the appropriate vocal responses to females and broadcasts of female calls. Lesioning the BNST in males produces an overall decrease in calling behavior. Taken together these results suggest that the CeA serves as a site of sensory integration that initiates socially appropriate vocal responses to female cues, while the BNST plays a broader role in vocal initiation.

**Symposium Schedule**

7. Keynote Speaker: Jim Pfaus (Jim.Pfaus@concordia.ca)

**THE PLEASURE PRINCIPLE REVISITED: HOW SEXUAL REWARD LINKS SEXUAL AROUSAL, DESIRE, AND PREFERENCE**

J. Pfaus

Center for Studies in Behavioral Neurobiology, Department of Psychology, Concordia University, Canada

Although sexual behavior is controlled by hormonal and neurochemical actions in the brain, sexual experience induces a degree of plasticity that allows animals to form flexible instrumental and Pavlovian associations that predict sexual outcomes, thereby directing the strength of sexual responding. Data will be presented showing how experience with sexual reward in rats strengthens the development of sexual behavior and induces sexually-conditioned place and partner preferences. In both male and female rats, early sexual experience with partners scented with a neutral or even noxious odor induces a preference for scented partners in subsequent choice tests. Conversely, conditioned place and partner preferences can be blocked by the opioid receptor antagonist naloxone. A somatosensory cue (a rodent jacket) paired with sexual reward comes to elicit sexual arousal in male rats, such that paired rats with the jacket off show dramatic copulatory deficits. We propose that endogenous opioid activation forms the basis of sexual reward, which also sensitizes hypothalamic and mesolimbic dopamine systems in the presence of cues that predict sexual reward. Those systems act to focus attention on, and activate goal-directed behavior toward, reward-related stimuli. Thus, a critical period exists during an individual's early sexual experience that creates a "love map" or Gestalt of features, movements, feelings, and interpersonal interactions associated with sexual reward.

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