

16<sup>th</sup> Annual

# Animal Behavior Conference

Indiana University

2009





# Hanna Kolodziejcki

July 18<sup>th</sup>, 1976 - February 3<sup>th</sup>, 2009

The 2009 CISAB Animal Behavior Conference is dedicated to the memory of Johanna A. Kolodziejcki ("Hanna"). Hanna was a cornerstone of the CISAB community during her graduate career at IU. She lost a long battle with cancer on February 3, 2009.

Hanna earned a bachelor's degree with honors in biology at Brown University in 1998 and joined the Evolution, Ecology, and Behavior graduate program at IU in 1999. Her research accomplishments epitomized the goals of CISAB. Hanna's interests focused on the broad themes of learning, communication, and sex differences in behavior; and she approached these questions at both proximate and ultimate levels of analysis. Her early graduate research in Bill Rowland's laboratory used classical ethological designs to investigate learning, memory, and escape responses in sticklebacks and zebrafish.

In her doctoral dissertation research, Hanna used elegant comparative experiments to understand the function, evolution, and neural mechanisms of sexually dimorphic communication signals in electric fish.

In addition to being an outstanding researcher, Hanna was committed to teaching and mentoring students. She mentored several undergraduate research interns in the NSF-sponsored REU program in Animal Behavior and the NIH-sponsored MEDIC-B program. Hanna's passion for science inspired these students to pursue scientific careers. After obtaining her PhD in 2007, Hanna was appointed as an Assistant Professor of Biology at Keene State College in New Hampshire, where she continued her commitment to research, education, and mentoring.

Hanna's impact extended well beyond the walls of the university. She had a well-developed social conscience and acted on it. She was a member of the AmeriCorps National Civilian Community Corps. She was politically active and demonstrated her opposition to the war in Iraq. Her love of animals and commitment to animal welfare was apparent in her involvement with Wild Care, which rehabilitates animals injured by human intervention. She volunteered at the Shalom center, which provides hot meals to low income members of our community. She was also a highly effective organizer and fund raiser for the American Cancer Society's Relay for Life and the Leukemia and Lymphoma Society's Team in Training program.

Hanna was a Herman B Wells graduate fellow. This highly prestigious award recognizes students who demonstrate "leadership abilities, academic excellence, character, social consciousness, and generosity of spirit." Hanna expressed all of these traits, and was the ideal recipient. She also received numerous grants and fellowships, including CISAB awards, a dissertation year fellowship, the Women in Science Program Leadership award, and several awards for her undergraduate research at Brown University.

Hanna is dearly missed by her friends and colleagues. A memorial award will be established in her name. The goal of the award will be to remember Hanna by honoring students who, like she did, possess outstanding academic promise in both research and teaching, while demonstrating a commitment to the community through service or outreach. (Contact info) for more information or to contribute to the endowment for this award.

# The 16<sup>th</sup> Annual Indiana University Animal Behavior Conference Schedule

Thursday, April 9

7:00– 10:00pm

7:00– 8:00pm

Hang Posters (IMU / Solarium)

Reception at CISAB, 402 N. Park Avenue (corner of 8<sup>th</sup> & Park)

Friday, April 10

7:30 — 8:00

8:00 — 8:25

8:25 — 8:30

Hang Posters & load talks

Continental breakfast

Welcome from CISAB director, Greg Demas

## ORAL PRESENTATIONS

### Session I

8:30 — 8:45

**Dawn O'Neal**

SEX AND LATITUDINAL DIFFERENCES IN IMMUNE FUNCTION IN A DIFFERENTIAL MIGRANT

8:45 — 9:00

**Tania del Rivero**

THE ROLE OF THE P38 MAP KINASE IN NEURONAL DEGENERATION

9:00 — 9:15

**Adam Walker**

FACILITATED EXTINCTION OF CONDITIONED FEAR IN THE R6/2 MOUSE MODEL OF HUNTINGTON'S DISEASE

9:15 — 9:30

**Katie Reimink**

NICOTINE INDUCED CIRCADIAN ENTRAINMENT AS A NOVEL TARGET FOR SMOKING CESSATION

9:30 — 9:45

**Nicole Gerlach**

WHICH DAD IS BEST? DO EXTRA-PAIR OFFSPRING DIFFER IN FITNESS FROM WITHIN-PAIR OFFSPRING?

9:45 — 10:00

**Refreshment Break**

### Session II

10:00 — 10:15

**Kenneth Henry**

AVIAN PITCH PROCESSING IN OPEN AND CLOSED HABITATS

10:15 — 10:30

**Grant Goodrich**

ANIMAL CONCEPTS

10:30 — 10:45

**Shanshan Zhou**

PLASTICITY OF THE CHEMORECEPTOR REPERTOIRE IN *DROSOPHILA MELANOGASTER*

10:45 — 11:00

**Mollee Farrell**

LESION OF MEDIAL PREFRONTAL CORTEX OCCLUDES STRESS-INDUCED CHANGES IN RECALL OF EXTINCTION

11:00 — 11:15

**Jeff Shapiro**

MALE SONG PERFORMANCE CORRELATES OF REPRODUCTIVE SUCCESS AND MORPHOLOGICAL CHARACTERS IN DARK-EYED JUNCOS (*JUNCO HYEMALIS*)

11:15 — 12:30

**Lunch Break (listing of local restaurants available at information table)**

**Session III**

12:30 — 12:45

**Emily Chester**

EFFECT OF IMMUNE ACTIVATION DURING PREGNANCY ON MOTHER AND OFFSPRING

12:45 — 1:00

**Megan Gall**

AVIAN BRAIN SIZE AND SUCCESS IN FRAGMENTED HABITATS

1:00 — 1:15

**Robert Bowers**

PATTERNS OF MATE CHOICE COPYING IN HUMANS

1:15 — 1:30

**Lisa Heimbauer**

SPOKEN-WORD RECOGNITION BY A LANGUAGE-TRAINED CHIMPANZEE (*PAN TROGLODYTES*) IN THE ABSENCE OF TRADITIONAL CUES TO PHONETIC CONTENT: IMPLICATIONS FOR SPEECH EVOLUTION

1:30 — 1:45

**Kathryn Smith**

UP-REGULATION OF GLT1 ATTENUATES CUE-INDUCED REINSTATEMENT OF COCAINE-SEEKING BEHAVIOR IN RATS

1:45 — 2:00

*Memorial for Dr. Hanna Kolodziejki*

2:00 — 3:20

**POSTER SESSION**

**Session IV**

3:20 — 3:35

**Harald Parzer**

THE EVOLUTION OF INSECT GENETILIA: TRADE-OFFS, RATES AND DEVELOPMENT

3:35 — 3:50

**Tom Verhovshek**

ANDROGEN DIFFERENTIALY REGULATES BDNF CONCENTRATIONS IN RAT SKELETAL MUSCLES

3:50 — 4:05

**Matt Druen**

GROWING UP GUPPY: EVOLUTION OF ANIMAL PERSONALITES

4:05 — 4:20

**Timothy Greives**

A SPRINGTIME KISS? UNCOVERING A ROLE FOR THE NEUROPEPTIDE KISSPEPTIN IN SEASONAL REPRODUCTION

4:20 — 4:30

**Awards Ceremony – Greg Demas**

4:30 — 5:30

**Plenary Speaker**

**Darcy Kelley**

KILLING ME SOFTLY WITH HIS SONG: A NEUROBIOLOGY OF VOCAL  
COMMUNICATION AND COMPETITION

7:30 — 9:30

**Evening Reception (Potluck dinner) Stone Age Institute**

***A special 'Thank You' to the Student Committee members for organizing the conference:***

Tim Greives

Mayte Ruiz

Emily Chester

Winnie Ho

James Klatt

Katy Lenz

Karen Bohorquez

Saul Nava

Kristal Cain

Katy Smith

Ben Miller

Jennifer Miller

Ian Hall

Rob Bowers

Mollee Farrell

Andrea Gillman

Aaron Wilber

Dawn O'Neal

Jacqueline Ho

Christy Bergeon

Yaniv Brandvain

Shely Ferguson

Adam Walker

**TALK PRESENTERS AND ABSTRACTS**  
**(in order of presentation)**

1. Dawn O'Neal (daoneal@indiana.edu)

**SEX AND LATITUDINAL DIFFERENCES IN IMMUNE FUNCTION IN A DIFFERENTIAL MIGRANT**

D.M. O'Neal<sup>1</sup>, L. Swager<sup>1</sup>, J.M. Jawor<sup>2</sup>, E.D. Ketterson<sup>1</sup>

<sup>1</sup>Indiana University, Bloomington, IN

<sup>2</sup>University of Southern Mississippi, Hattiesburg, MS

Many studies consider the role of mating systems and sexual selection in the evolution of sex differences. Less widely appreciated are sex differences in ecology that can alter habitat preference and migratory behavior. Such differences may cause males and females to settle in different locations giving rise to a pattern of distribution known as differential migration. The Dark-eyed Junco (*Junco hyemalis*) is differential migrant in which females move farther south in winter than males. Several hypotheses to explain these differences in migratory behavior exist. Examples include: intrasexual selection for breeding resources, intersexual competition for winter resources, and sex differences in body size and relative risk of mortality during migration. A hypothesis that has not been considered in this system, however, is intersexual differences in physiology. This hypothesis suggests that differentiation may be a product of inherent sex differences in physiology based on different responses to the same environment. We evaluated the potential role of immune function in mediating differential migration in wintering male and female juncos within and across a latitudinal gradient (i.e., Michigan, Indiana, and Mississippi). Birds were evaluated for innate immune measures including total IgG and complement activity. Results did not reveal sex differences in immune function but did suggest latitudinal differences with lower levels of total IgG but higher complement activity in northern birds. These results indicate a more complex relationship between immunity and differential migration than initially expected, and suggest possible tradeoffs between immune components and/or latitudinal differences in the nature of infection.

2. Tania del Rivero (ta\_de\_ri@hotmail.com)

**THE ROLE OF THE P38 MAP KINASE IN NEURONAL DEGENERATION**

T. del Rivero, S. Sanyal, A. Vrailas

Cell Biology Department, Emory University, Atlanta, GA

p38 kinase is a member of the well-studied MAP Kinase family of protein kinases that are collectively involved in a variety of cellular signaling pathways. The p38 kinase in particular, regulates response to different types of stress, such as oxidative stress. According to the oxidative stress theory of aging, oxidative stress damages DNA, lipids, and proteins which ultimately leads to apoptotic death of many cell types in an organism. In Parkinson's disease patients, the neurons are particularly vulnerable to these deleterious effects which results in a large loss of neurons, specifically dopaminergic neurons. This suggests there could be a direct relationship between the p38 kinase and Parkinson's Disease. Preliminary work in the Sanyal lab has shown that fruit flies with a simultaneous knockout for the two p38 kinase genes show a host of phenotypes reminiscent of Parkinson's disease patients such as locomotor behavior deficits, increased sensitivity to oxidative stress and reduced lifespan. To further explore the effect of the p38 signaling pathways on fly behavior we have subjected flies with a mutation in the p38 kinase gene to a number of screens testing locomotor behavior such as walking, climbing, geotaxis and flight. We are also recording the lifespan of the p38 mutants and comparing these to wildtype flies. Upon conclusion my experiments will confirm the effect of p38 kinase on normal nervous system function and characterize behavioral defects that arise from a loss of p38 kinase activity in neurons.

3. Adam Walker (agwalker@indiana.edu)

**FACILITATED EXTINCTION OF CONDITIONED FEAR IN THE R6/2 MOUSE MODEL OF HUNTINGTON'S DISEASE**

A.G. Walker, C.L. Wellman, G.V. Rebec  
Program in Neuroscience and Department of Psychological & Brain Sciences,  
Indiana University, Bloomington, IN

We have recently shown that multiple aspects of information processing in the prefrontal cortex (PFC) are altered in behaving R6/2 mice relative to wild-type (WT) controls. To determine if these alterations are sufficient to affect behavior, we evaluated performance of R6/2 and WT mice on extinction of conditioned fear, which is at least partially mediated by PFC. Acquisition of conditioned fear took place on day one with three pairings of a tone conditioned stimulus (CS) with a footshock. After a 24h consolidation period, CS recall was tested and extinction training took place with 40 CS-alone presentations. To assess conditioned fear responses, the amount of time spent freezing during the tone presentation was measured. Acquisition of conditioned fear was comparable across genotypes on day one with both R6/2 and WT mice exhibiting a high degree of freezing by the third trial. During the second day of training, both R6/2 and WT mice exhibited similar amounts of freezing during the first two CS presentations. R6/2 mice, however, demonstrated a facilitation of extinction with subsequent CS alone presentations. By the fourth trial on day two, freezing in R6/2s was near baseline levels (<15%), but still relatively high in WT (~40%). Furthermore, electrophysiological recordings during extinction indicate that processing of the CS by PFC is impaired in R6/2 relative to WT. Thus, disruptions in PFC activity patterns in R6/2 mice are sufficient to alter behavior dependent upon this region.

Supported by the National Institute of Neurological Disorders and Stroke RO1 NS35663 to GVR.

4. Katie Reimink (Katie.Reimink05@kzoo.edu)

**NICOTINE INDUCED CIRCADIAN ENTRAINMENT AS A NOVEL TARGET FOR SMOKING CESSATION**

K.M. Reimink<sup>1</sup>, A. Gillman<sup>2</sup>, W. Timberlake<sup>2</sup>

<sup>1</sup>Department of Psychology, Kalamazoo College, Kalamazoo, MI

<sup>2</sup>Department of Psychological and Brain Sciences, Indiana University Bloomington, IN

Circadian rhythms have been shown to be modulated by the daily administration of dependence forming drugs. Daily nicotine administration in rats has been shown to act as a zeitgeber for the entrainment of circadian activity rhythms. Nicotine-induced entrainment shows both anticipatory activity (PRE) beginning 2 hr before the injection time and a drug-evoked increase in post-injection (POST) activity. A treatment for nicotine abuse may lie in the ability to eradicate entrainment to the drug administration time. Mecamylamine (MEC), a nicotinic acetylcholine receptor antagonist (nAChR), has been therapeutically used to help decrease nicotine consumption. The present study used 48 adult female Sprague-Dawley rats (*Rattus norvegicus*) separated equally into 6 groups: half dosed with nicotine and the other with saline with 3 different treatment possibilities, "cold turkey", saline injections, and MEC. The subjects were housed in wheel boxes under constant dim light and rate limited feeding. The rats underwent two subcutaneous injection series (1 ml/kg nicotine or 1 ml/kg saline, corresponding to group membership), followed by 2 treatment days, and 4 baseline days administered over 36 days. Most interestingly, MEC treatment showed significant decreases in nicotine POST entrainment activity during the treatment days, with increased PRE withdrawal-like activity, whereas the cold turkey and saline treatments showed no changes in PRE or POST activity in response to treatment. The partial, but not complete, elimination of entrained behavior provides evidence that separate oscillators modulate drug seeking and drug-evoked behaviors.

5. Nicole Gerlach (nmgerlac@indiana.edu)

**WHICH DAD IS BEST? DO EXTRA-PAIR OFFSPRING DIFFER IN FITNESS FROM WITHIN-PAIR OFFSPRING?**

N.M. Gerlach<sup>1</sup>, P.G. Parker<sup>2</sup>, E.D. Ketterson<sup>1</sup>

<sup>1</sup>Indiana University, Bloomington, IN

<sup>2</sup>University of Missouri, St. Louis MO

Extra-pair mating is easily understood from the male's perspective – a male's reproductive success will increase if he mates with multiple females. Less clear is why females participate in this behavior. One explanation that is frequently put forward is that females are mating with attractive, healthy, or otherwise "fit" males in order to secure "good genes" for their offspring. The main prediction of this hypothesis is that extra-pair young (EPY) will out-perform within-pair young (WPY) on one or several measures of fitness. We have tested this prediction with data from a long-term study of a free-living population of dark-eyed juncos (*Junco hyemalis*). Using DNA collected over 18 years (1990-2007), we have assigned paternity to over a thousand nestlings, and can compare EPY and WPY performance on a variety of fitness metrics, including early growth, fledging likelihood, recruitment, and reproduction.

6. Kenneth Henry (kshenry@purdue.edu)

**AVIAN PITCH PROCESSING IN OPEN AND CLOSED HABITATS**

K.S. Henry and J.R. Lucas

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

The physical characteristics of the habitat influence the optimal design of acoustic signals used for long range communication. In songbirds, species occupying dense forests tend to sing low frequency songs to avoid reverberations occurring above 3 kHz, while species occupying open areas are free to sing at higher frequencies. Here, we test whether divergence in the frequency range of songs between habitat types has been accompanied by divergence in the frequency range of fine frequency resolution of the auditory system (i.e. ability to judge pitch differences). We measured peripheral auditory frequency resolution of 5 species at 2, 3, and 4 kHz using auditory brainstem responses to tone bursts in notch-filtered masking noise. As predicted, woodland species tended to have finer resolution than open-habitat species at 2 kHz, but resolution at 4 kHz was largely independent of habitat type. We discuss how variation in frequency resolution at 4 kHz may be related to the relative salience of frequency modulation versus amplitude modulation present in songs.

7. Grant Goodrich (gtgoodri@indiana.edu)

**ANIMAL CONCEPTS**

G. Goodrich

History and Philosophy of Science, Indiana University, Bloomington, IN

Machery (2009) argues that philosophers and psychologists have little to say to one another about the nature of concepts. The reason, he says, is that philosophers are primarily interested in the necessary and sufficient conditions for concept possession, while psychologists tend to theorize about the kind of structures that make up concepts. These two projects, according to Machery, have little in common. While Machery may be correct about these two approaches, he ignores the study of concepts in animals. The study of concepts in animals is focused, not on the nature of the structure of concepts, but on the conceptual abilities of the animal. I argue that the study of conceptual abilities of animals is relevant both to philosophy and to the more general psychological study of concepts.

8. Shanshan Zhou (szhou@ncsu.edu)

**PLASTICITY OF THE CHEMORECEPTOR REPERTOIRE IN *DROSOPHILA MELANOGASTER***

S. Zhou

Department of Biology, North Carolina State University, Raleigh, NC

Individuals interact with and adapt to their chemosensory environments differently under different developmental, physiological and social conditions. *Drosophila melanogaster* presents an excellent model for assessing plasticity in expression of the chemoreceptor repertoire, as both the genotype and environment can be controlled precisely. To assess to what extent transcription of chemosensory genes responds to changing conditions, we constructed cDNA expression arrays that represent 50 Odorant binding protein (Obp), 59 Odorant receptor (Or), and 59 Gustatory receptor (Gr) genes, 4 genes that encode other antenna-specific proteins, and 4 control genes. We compared transcriptional profiles under different environmental and physiological conditions. All experiments were done with isogenic Canton S (B) flies with sexes separately. We observed that chemoreceptor genes that are organized as clusters in the genome are independently regulated; sexual dimorphism in chemoreceptor expression is pervasive; and, chemoreceptor expression patterns are plastic throughout development as evident from larva-specific gene expression and altered regulation of gene expression during senescence. Furthermore, expression of subsets of chemoreceptors is modulated by physiological state (virgin vs. mated) and social context (solitary or group-reared). We analyzed covariance in transcript abundance of chemosensory genes across all environmental conditions and found that they segregated into 20 relatively small covariant transcriptional modules, allowing groups of chemosensory genes to alter their expression levels independently under a wide range of external environmental conditions. The observed plasticity in chemoreceptor gene expression reflects functional diversity of the chemoreceptor ensemble attuned to ecologically relevant environmental and physiological conditions.

9. Mollie Farrell (mrfarrel@indiana.edu)

**LESION OF MEDIAL PREFRONTAL CORTEX OCCLUDES STRESS-INDUCED CHANGES IN RECALL OF EXTINCTION**

M.R. Farrell, J.A. Sayed, A.R. Underwood, C.L. Wellman

Department of Psychological and Brain Sciences and Program in Neuroscience,  
Indiana University, Bloomington, IN

We have shown that one week of chronic restraint stress produces dendritic reorganization in medial prefrontal cortex (mPFC) and impairs recall of extinction of conditioned fear. This behavior is prefrontally mediated: neuronal activity in mPFC models recall of extinction, and lesions of mPFC impair recall of extinction. To test if stress-induced changes in mPFC are responsible for the stress-induced impairment of extinction recall, we assessed whether lesion of mPFC occludes the stress-induced impairments in this behavior. After bar press training to obtain a baseline against which to measure freezing, rats received either sham or ibotenic acid lesions of mPFC. After recovery, rats were either unstressed or underwent daily restraint stress (3h/day) for one week. Then, rats received 5 habituation trials to a 30-sec tone, followed by 7 pairings of the tone and footshock. After a 1 h delay, rats received tone-alone extinction trials until they showed < 10% freezing on 4 consecutive trials. Over the next 5 days, rats were given 2 extinction trials per day to test for extinction recall. Percent freezing was assessed during all phases of training. Neither mPFC lesion nor one week of restraint stress altered acquisition or extinction of the conditioned fear response. However, either lesion or stress impaired extinction recall. Furthermore, the combination of mPFC lesion and stress did not produce a larger extinction recall deficit. Thus, lesion of mPFC occluded the effect of stress on recall of extinction, suggesting that stress-induced impairment of extinction recall is mediated by changes in mPFC.

10. Jeff Shapiro (raptorjeff@gmail.com)

**MALE SONG PERFORMANCE CORRELATES OF REPRODUCTIVE SUCCESS AND MORPHOLOGICAL CHARACTERS IN DARK-EYED JUNCOS (*JUNCO HYEMALIS*)**

J.W. Shapiro<sup>1</sup>, D.G. Reichard<sup>2</sup>, E.D. Ketterson<sup>2</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>Department of Biology, Indiana University, Bloomington, IN

Within given populations of sexually reproducing species, there exists a wide range of phenotypic variation. Male diversity is commonly used by females to judge male quality. In songbirds, one such male phenotypic trait is song and in many species male song performance can be used as a predictor of individual quality and subsequently reproductive success. Male Dark-eyed Juncos (*Junco hyemalis*), a small North American songbird, typically sing a single, repeated, high-pitched trill. Due to motor constraints, a male's trill rate constrains its frequency bandwidth. A "high performance" song is one which the frequency bandwidth approaches the physiological limit for a given trill rate. Therefore, physically robust males should sing higher performance songs. This study investigates if A) junco song performance is correlated to reproductive success? and B) if junco song performance is correlated to other phenotypic measures of male quality? We recorded the songs of 65 male juncos, measured various morphological characters, took blood samples, and tracked their nesting success over the course of the 2008 breeding season. Results are not statistically significant, yet trends suggest that higher performance singers are more physically robust males. Surprisingly though, better singers had lower apparent reproductive success than poor-singing competitors. However, robust males are known to have higher actual reproductive success due to more extra-pair fertilizations and therefore we expect results of paternity analysis (still pending) to demonstrate equal or higher reproductive success for high-performance singers.

11. Emily Chester (emcheste@indiana.edu)

**EFFECT OF IMMUNE ACTIVATION DURING PREGNANCY ON MOTHER AND OFFSPRING**

E.M. Chester, S.S. French, G.E. Demas

Center for the Integrative Study of Animal Behavior and Department of Biology,  
Indiana University, Bloomington, IN

One assumption in life-history theory is that resources available for competing life functions (i.e., growth, reproduction and somatic maintenance) are limited, and resources allocated toward one function cannot be used for another. For instance, mounting an energetically costly immune response during pregnancy may result in long-term consequences for offspring due to a trade-off between investment in immune function and investment in reproductive effort. We test this hypothesis by examining Siberian hamsters (*Phodopus sungorus*) born to mothers injected with either lipopolysaccharide (LPS) or saline during pregnancy. LPS is the active fragment of the cell wall of Gram-negative bacteria that elicits an inflammatory response, providing a valid and reliable simulator of sickness in the absence of the actual pathogen. Results indicate that LPS induces a decrease in food intake and body mass in the mothers. Other offspring measurements will include several indices of immune function, as well as the behavioral response to a resident-intruder interaction. Collectively, the results of this study contribute to the understanding of the epigenetic effects induced by the activation of the immune response during pregnancy.

12. Megan Gall (mgall@purdue.edu)

### **AVIAN BRAIN SIZE AND SUCCESS IN FRAGMENTED HABITATS**

M.D. Gall and J. Lucas

Biology Department, Purdue University West Lafayette, IN

Habitat fragmentation presents a number of challenges for species including increased environmental variability and predation pressure, as well as alteration of habitat structure and the distribution of resources. Cognitive flexibility, a suite of traits that may confer an advantage when confronted with a new environment (e.g. novel anti-predator behaviors, novel food items consumption, tool-use) is strongly correlated with brain size. Species with larger brain sizes, therefore, may be more successful in fragmented habitats. An alternative, although not mutually exclusive, hypothesis is that an increase in size of specific areas of the brain, such as the hippocampus, may confer an advantage to species in fragmented landscapes. Species with greater spatial memory, a cognitive characteristic that is strongly correlated with hippocampus size, may be more successful in navigating and accessing resources in fragmented landscapes, which may represent a more complex spatial arrangement of resources (e.g. patchily distributed food sources or nesting sites). Here we assessed the relationship of both brain size and hippocampal size with success in fragmented habitats, controlling for phylogenetic relationships, migratory behavior, life history strategy, and diet.

13. Robert Bowers (ribowers@indiana.edu)

### **PATTERNS OF MATE CHOICE COPYING IN HUMANS**

R. Bowers<sup>1</sup>, P.M. Todd<sup>1</sup>, S. Place<sup>1</sup>, L. Penke<sup>2</sup>, J.B. Asendorpf<sup>3</sup>

<sup>1</sup>Indiana University, <sup>2</sup>University of Edinburgh, <sup>3</sup>Humboldt University

Mate choice decisions are generally assumed to be made independently of others' mate choices. However, females of several species have been shown to copy the sexual preferences of conspecific females. This is known as Mate choice copying, a form of non-independent mate choice. If mate choice is not independent, sexual selection will be systematically impacted. Such an effect will depend on whether the change is specific to the individual observed, or generalises to other potential mates with common characteristics. A human that is seen in a positive interaction with an opposite-sex conspecific is, more often than not, thereafter regarded more appealing as a potential mate, evidencing mate choice copying. The extent that this effect generalises to other potential mates with shared characteristics is investigated.

14. Lisa Heimbauer (lisa.heimbauer@gmail.com)

**SPOKEN-WORD RECOGNITION BY A LANGUAGE-TRAINED CHIMPANZEE (*PAN TROGLODYTES*) IN THE ABSENCE OF TRADITIONAL CUES TO PHONETIC CONTENT: IMPLICATIONS FOR SPEECH EVOLUTION**

L.A. Heimbauer, M.J. Beran, M.J. Owren

Psychology Department and The Language Research Center, Georgia State University, Atlanta, GA

Ability of human listeners to understand speech in altered or synthetic forms is argued as evidence of uniquely human processing abilities. Alternatively, human speech may have evolved on a foundation of auditory capabilities shared with other primates and mammals. To investigate this, we tested the performance of Panzee, a 22-year-old language-trained chimpanzee (*Pan troglodytes*), in recognizing altered speech. Panzee was reared from early infancy by human caregivers who treated her, and spoke to her, as if she were a human infant. Her word-recognition abilities of natural speech are well documented and shown through her ability to use graphical symbols, called lexigrams. Experimental training and testing were conducted with different sets of familiar words presented in natural or altered form with Panzee choosing one of four lexigrams. Experiment 1, presenting “voiced-only” words, resynthesized from only voiced components of a word, showed performance significantly above chance rate of 25% and equivalent to words heard in natural form. Noise-vocoded words presented in Experiment 2, were based on amplitude-modulated noise bands, simulating effects of hearing using a cochlear implant. Performance with these sounds was significantly higher than chance, although statistically lower than with voiced-only and natural words. Overall, Panzee was able to recognize English words in both synthetic forms at rates well above, and statistically different, from chance levels. Results suggest that specialized, human processing mechanisms are not necessary for speech perception in the absence of traditional acoustic cues, and that early learning and enculturation likely play a critical role in this ability.

15. Kathryn Smith (Kdfische@indiana.edu)

**UP-REGULATION OF GLT1 ATTENUATES CUE-INDUCED REINSTATEMENT OF COCAINE-SEEKING BEHAVIOR IN RATS**

K.D. Smith, Y. Sari, P.K. Ali, G.V. Rebec

Indiana University, Bloomington, IN

Relapse to cocaine-seeking behavior depends on increased glutamate transmission in key regions of the mesocorticolimbic motive circuit, including prefrontal cortex (PFC) and nucleus accumbens (NAcc). Because GLT1 is responsible for the uptake of  $\geq 90\%$  of extracellular glutamate, we tested the hypothesis that increased GLT1 expression attenuates cocaine relapse. Rats were trained to self-administer cocaine (0.125 mg per iv infusion) in a lever-pressing task in a daily two-hour session for 10-14 days followed by five days of extinction training. Immediately after each extinction session, rats received ceftriaxone (ip), a  $\beta$ -lactam antibiotic believed to increase GLT1 expression, or vehicle. On the following day, presentation of the cue (light and tone) previously associated with cocaine self-administration reinstated lever pressing in rats treated with either vehicle or 50 mg/kg ceftriaxone, whereas 100 or 200 mg/kg blocked this response. Immunoblotting confirmed that the ceftriaxone-induced blockade of cocaine relapse was associated with an increase in GLT1 expression in both PFC and NAcc. Our results suggest that glutamate plays a key role in cue-induced relapse to cocaine-seeking behavior, implicating GLT1 as a potential therapeutic target for cocaine addiction.

16. Harald Parzer (hparzer@indiana.edu)

### **THE EVOLUTION OF INSECT GENETILIA: TRADE-OFFS, RATES AND DEVELOPMENT**

H. Parzer and A. Moczek

Department of Biology, Indiana University, Bloomington, IN

The evolution of male genitalia in insects is still considered as a “mystery of mysteries”: on one hand even closely related species exhibit highly diversified genitalia, which serve for many species as the only source for identification. On the other hand, genitalic variation within species is unexpectedly low, compared to the variation seen in other classes of traits. Therefore, it remains unclear how this low level of within species genitalic variation could fuel the extraordinary diversity of genitalia observed between species. To address the evolution of insect genitalia we are using species of the dung beetle genus *Onthophagus*, which recently established as a promising model system for integrating ecology, evolution and development. Here, we will present data which indicate that trade-offs between primary and secondary sexual characters might trigger rapid diversification between populations and species. However, shape and size evolve under different rates, indicating that most of the genitalic diversity observed between species is caused by changes in shape and not in size. To further elucidate the evolution of genitalia we are conducting a functional analysis of patterning genes (e.g. *distalless* and *abdominal B*), which will allow us to understand the evolution of genitalia by understanding its development.

17. Tom Verhovshek (tverhovs@indiana.edu)

### **ANDROGEN DIFFERENTIALLY REGULATES BDNF CONCENTRATIONS IN RAT SKELETAL MUSCLES**

T.Verhovshek and D.R.Sengelau

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Trophic factors, such as brain-derived neurotrophic factor (BDNF), play an important role in the maintenance of motoneuron morphology and function in adulthood, which in turn are critical for the expression of behavior. Previous studies from our laboratory have demonstrated that a peripherally-derived source of BDNF is critical to the maintenance of dendritic morphology in spinal motoneurons (Yang et al., 2004). One possible peripheral source of BDNF is the target musculature, and BDNF is in fact present in the sexually dimorphic bulbocavernosus (BC) muscle of the penis (Yang and Arnold, 1999), as well as the non-dimorphic quadriceps muscle (Koliatsos et al., 1993). Interestingly, BDNF interacts with testosterone (T) to regulate dendritic morphology of spinal motoneurons. Given the dependence on peripherally-derived BDNF and the interactive effects of T and BDNF on spinal motoneurons, we examined whether androgens regulate BDNF in the target musculature of two populations of spinal motoneurons. In BC muscles, castration increased BDNF concentration by 358% compared to that of gonadally intact males, and this increase was prevented with T-treatment. In contrast, in quadriceps muscles, castration decreased BDNF concentration by 51%, and T-treatment maintained BDNF concentration at the level of intact males. These results provide evidence that BDNF is differentially regulated by androgens in sexually dimorphic versus non-dimorphic muscles. Furthermore, these results support the hypothesis that spinal motoneuron morphology is dependent of trophic substances released from the periphery whose actions are regulated by androgens.

18. Matt Druen (mwdru01@louisville.edu)

**GROWING UP GUPPY: EVOLUTION OF ANIMAL PERSONALITIES**

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A quantitative genetics approach was used to investigate the development and evolutionary meaning of variation in complex behavioral traits in two populations of Trinidadian guppies (*Poecilia reticulata*). Full and half-sib groups were examined in four ecological contexts (exploration of a novel environment, behavior under predation threat, foraging in home-cage, and shoaling with conspecifics) at two points during their development (juvenile & adult). Preliminary findings will be presented on the phenotypic and genetic structure of relationships among behaviors in the context of adaptive responses to selective environments.

19. Timothy Greives (tjgreive@indiana.edu)

**A SPRINGTIME KISS? UNCOVERING A ROLE FOR THE NEUROPEPTIDE KISSPEPTIN IN SEASONAL REPRODUCTION**

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Department of Psychology, University of California, Berkeley, CA

Most non-tropical animals exhibit seasonal bouts of reproduction, and photoperiod acts as the main environmental cue regulating the timing of breeding. The integration of photoperiod cues ensures offspring are born during favorable environmental conditions. The precise mechanisms by which photoperiodic information are integrated to directly regulate the reproductive neuroendocrine axis has, however, remained less well specified. The neuropeptide kisspeptin has recently been identified as a potent positive regulator of reproduction and is associated with the onset of puberty in mammals. We investigated the role of kisspeptin in regulating seasonal changes in reproduction in the photoperiodic Siberian hamsters (*Phodopus sungorus*). The reproductive neuroendocrine axis of Siberian hamsters is tightly regulated by changes in photoperiod; hamsters held in “summer-like” long-days maintain fully functional gonads, while animals held “winter-like” short-days regress their gonads and are reproductively quiescent. To begin to uncover the role of kisspeptin in seasonal reproduction, hamsters were subjected to hormonal and photoperiod manipulations; hamsters were housed either in “summer-like” long days (L:D 16:8) or “winter-like” short days (L:D 8:16). The effects of hormonal and photoperiod manipulation on the kisspeptin system and the effects of kisspeptin on the reproductive neuroendocrine axis in reproductive and non-reproductive hamsters will be presented. Further, the potential role of kisspeptin as a key modulator of seasonal reproductive activity will be discussed.

20. Darcy Kelley (dbk3@columbia.edu)

**KILLING ME SOFTLY WITH HIS SONG: A NEUROBIOLOGY OF VOCAL COMMUNICATION AND COMPETITION**

D. Kelley

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Vocal communication requires precise coordination between hearing and utterance using neural substrates that match vocal responses to what is being heard. Our goal is to understand how vocal coordination is achieved through neuroethological experiments on the role of specific brain nuclei in a well established model system: the underwater songs of the South African clawed frog, *Xenopus laevis*. Our experimental approaches include analysis of specific circuits known to be important for vocal communication using in vitro and in vivo approaches as well as field and laboratory tests of how vocalization depends on social context and is controlled by neuroendocrine regulation of key circuits. The species-specific songs of the genus allow us to study genetic changes associated with the evolution of vocal characters.

**POSTER PRESENTERS AND ABSTRACTS  
(in alphabetical order of presenter's name)**

1. Jennifer (Jef) Akst (jakst@indiana.edu)

**MALES LINED SEAHORSES (*HIPPOCAMPUS ERECTUS*) PREFER FAMILIAR FEMALES**

J. Akst

Department of Biology, Indiana University, Bloomington, IN

Seahorses (genus *Hippocampus*) show a unique form of paternal care, in which males carry the fertilized eggs in a specialized brood pouch until the offspring have reached independence. Most seahorse species studied to date have been found to form monogamous mating pairs, with partners mating exclusively for the entirety of the breeding season. To address the effect of familiarity of partner on mate-choice, I observed the courtship behaviour of male *H. erectus* housed with one female for five days, followed by that addition of a second female for one day. After the addition of the second female, males spent significantly more time courting the original, familiar female and performed significantly more of each of five courtship behaviors measured. Furthermore, the courtship appeared to be qualitatively different depending on whether it was directed at the familiar female or the new female. These results suggest that this species does stick with mates that they have paired with and that the pair bond may form in just a few days, even in the absence of copulation.

2. Arián Avalos (avala01@ipfw.edu)

**PREDATOR PERSISTENCE AND PREY HABITUATION, TWO EXTREMES OF PREDATORY ENCOUNTERS**

A. Avalos

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Optimal escape theory explains variation in prey response during a predation event. The theory predicts prey will respond more readily with increasing risk of predation. Here, I consider anti-predatory responses, flight and refuge use, of the mountain spiny lizard (*Sceloporus jarrovi*) to short term predator persistence and long term predator habituation. In order to test this, I acted as a model predator and approached lizards at a designated speed until they fled, repeating this approach to model predator persistence. I measured prey response as flight initiation distance (FID), the distance between predator and prey when the prey flees, and as emergence time, the time prey spends inside a refuge following a predation event. I further measured FID of lizards in two populations differing in degree of human inhabitation to determine how habituation to predators may additionally influence prey response. Under predator persistence, lizards fled sooner (greater FID) on the second approach than on the first. Similarly, emergence time was greater after the second approach than the first. These results indicate that lizards perceive an increased risk of predation in the second approach, prompting them to more readily respond by fleeing sooner or waiting longer to leave refuge. We find opposite results when considering habituation; lizards with territories near human populated areas had shorter FID than those living in areas of lower human population. In this way, habituation to an unresponsive predator can lower perceived risk of predation. Thus, perceived predation risk can be an important factor in anti-predatory response decisions.

3. Nicole Beckage (nbeckage@indiana.edu)

### **TESTING SEQUENTIAL PATTERNS IN HUMAN MATE CHOICE USING SPEED DATING**

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Choosing appropriate mates from the sequential stream of possible partners we encounter over time is a crucial and challenging adaptive problem. But getting data on mate search is also challenging. Speed-dating provides an accelerated microcosm of such data which we can use to test models of sequential mate search. Here we use such data to assess search heuristics including fixed threshold models and mechanisms that adjust aspiration levels for mates in response to previous experiences of success or failure on the mating market. We find that initial thresholds related to own attractiveness combined with experience-based threshold adjustment can account for most of the offers made during speed-dating.

Keywords: mate choice; sequential mate search; aspiration level; satisficing; speed-dating

4. Christine Bergeon Burns (cbergeon@indiana.edu)

### **PHENOTYPIC INTEGRATION OF TESTOSTERONE-MEDIATED CHARACTERS ACROSS DISTINCT SUBSPECIES OF THE DARK-EYED JUNCO**

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Indiana University, IN

Male dark-eyed juncos (*Junco hyemalis*) vary in how much they elevate testosterone (T) in response to a standardized injection of gonadotropin releasing hormone (GnRH). Responses to a GnRH challenge are repeatable across individuals and co-vary with significant phenotypic characters, including aggression and ornamentation (tail white). However, the question of whether such patterns are preserved as species diverge remains unanswered, as few studies have attempted direct comparisons of hormone-phenotype relationships across populations. If these relationships are highly integrated, we would expect similar patterns, but if hormone signal and hormone response evolve independently we might not. The white-winged junco (*J. hyemalis aikenii*) is a subspecies of dark-eyed junco endemic to the Black Hills of South Dakota. It is the largest of 15 named junco subspecies and the most highly ornamented. We asked whether hormone-phenotype relationships already identified within a population of Carolina junco (*J. hyemalis carolinensis* residing in Virginia) would generalize to the white-winged junco, and whether the responses would be stronger in this more ornamented population. During 2007 and 2008, we captured, measured, and administered GnRH challenges to breeding male white-winged juncos. We found similar within-population relationships between T and phenotype, suggesting generalizability. We also found greater elevation of T in response to GnRH in the white-winged junco as we had predicted. Our findings suggest stable hormone-phenotype relationships across populations maintained at least in part by variation in hormone signal, thus supporting the hypothesis of phenotypic integration.

5. Sonya Bierbower (sbierbower@uky.edu)

### **MOTOR TASK LEARNING AND RETENTION IN CRAYFISH**

S.M. Bierbower and R.L. Cooper

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A powerful tool to study learning is the analysis of an animal's ability to learn to complete a task. For invertebrates, there have been limited studies examining this area of interest. Operant conditioning, which is behavior controlled by its' consequences, is not as well studied as other areas such as classical conditioning or habituation and sensitization. A key component of operant conditioning is that some aspect of the motor response is involved with learning. Here, I used crayfish to study the ability to complete a specific motor task which consists of manipulating a cheliped (large claw) through a cheliped-sized access point in a plexiglas divider and remove a worm tethered above the access point. Learning is based on time to complete the task while memory formation/retention is based upon changes in task efficiency over repeated access in the experimental chamber. Furthermore, delays in time (i.e., 4, 7, 93-day) specifically examine periods of time impacting learning capability. Preliminary findings conclude that crayfish are able to successfully complete the motor task. In addition, crayfish showed a non-significant decrease in task efficiency through time comparison analysis after each of the introduced time delays. Thus, this study concludes that crayfish can not only learn a motor task, but they are capable of long-term memory retention. Future goals are to address the influence of environmental and physiological manipulation on learning a task and retention.

6. Yaniv Brandvain (ybrandva@indiana.edu)

### **SIMULTANEOUS IDENTITY BY DECENT OF MATERNALLY AND PATERNALLY INHERITED AND THE EVOLUTION OF IMPRINTED GENES**

Y. Brandvain

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Genomic imprinting, or a Parent-of-origin effect on gene expression is a peculiar form of gene expression which has received much attention from evolutionary theorists. The kinship theory explains genomic imprinting as a consequence of conflicting evolutionary forces on maternally and paternally inherited genes. The underlying logic of the kinship theory depends on differential relatedness of matrilineal siblings via maternally and paternally inherited alleles. As maternal siblings are more closely related via maternally inherited genes, genes expressed when maternally inherited are expected to be "altruistic" with functions that increase family fitness and reduce individual fitness. By contrast, genes expressed when paternally inherited are expected to increase individual fitness at a cost to matrilineal groups. Here I formalize this argument by calculating the probability of simultaneous identity by decent (s-ibd) of maternally and paternally inherited genes at a given locus within and among matrilineal family groups. I investigate a wide array of inbreeding regimes and degrees of multiple paternity per brood, and show that s-ibd provides a measure of the degree of conflict/cooperation among loci, much like one locus measures of identity by decent (ibd,  $F$ ,  $r$ ) measures the efficacy of the response to selection on pro-social behaviors. I then expand this work to include conflict and cooperation across loci with unusual forms of transmission and population structures, and the connection between population genetic theory and recent discovery of imprinting in genes expressed in the brain.

7. Lauren Brierley (lbrierle@purdue.edu)

**IMPACTS OF HABITAT FRAGMENTATION FROM FOREST MANAGEMENT ON SOCIAL BEHAVIOR, VOCAL COMMUNICATION, AND PHYSIOLOGICAL STRESS IN CAROLINA CHICKADEES (*POECILE CAROLINENSIS*)**

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Previous research on habitat fragmentation's influence on social behavior suggests that understanding social behavior and vocal interactions may be of significant importance for conservation efforts. Fragmentation-induced changes in social behavior may alter the functioning of social groups (via communication and behavior) making physiological stress more pronounced in individuals of different social status. The fragments created by different forest management techniques will be used to investigate how fragmentation can influence social behavior, physiological stress, and vocal communication in Carolina chickadees (*Poecile carolinensis*). Carolina chickadees are an ideal model organism because they have complex social system which has allowed them to evolve a unique vocal system. A disruption in the social system and a change in stress level are predicted to cause a change in chickadee's vocal communication. Birds will be color banded, and measurements of physiological traits that indicate the animal's health and stress level will be taken. Color bands will allow for identification of individual birds during vocal recordings and behavioral observations so that physiological and behavioral data can be correlated. Behavioral observations will be taken to determine individual bird's social rank, flock and mate-pair territory establishment and defense, and social interactions in response conspecifics and predators. Vocal recordings will be taken in conjunction with behavioral observations in order to see if changes in behavior and vocal communication correlate. Additionally, stress levels will be compared to the behavioral and vocal data to determine if birds with altered social interactions are experiencing more stress and using different vocal communication. Although limited data has presently been collected on this work, previous work done at a site local to West Lafayette, IN suggest that chickadees within uniform forests use different vocalizations than chickadees in disturbed forest. These data could be important in helping to identify and screen for more complex impacts of fragmentation caused by forest management techniques.

8. Joel Cavallo (jcavallo@indiana.edu)

**MULTIPLE SOURCES OF LIGHT-EVOKED INTRACELLULAR CALCIUM INCREASES IN HERMISSENDA TYPE B PHOTORECEPTORS: EXTRACELLULAR CALCIUM INFLUX AND ER STORE RELEASE**

J. Cavallo, B. Hallahan, J. Johnson, J. Farley

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Previous research suggests that learning-produced changes in excitability and K<sup>+</sup> currents of Hermissenda Type B photoreceptors are Ca<sup>2+</sup>-dependent phenomena. Little information is available concerning the sources and dynamics of Ca<sup>2+</sup> in these cells. We used Fura-2 dual-wavelength photometry to measure somatic [Ca<sup>2+</sup>]<sub>i</sub> in B cells. Thirty sec light steps (LS) produce large increases in [Ca<sup>2+</sup>]<sub>i</sub> (~ 246%). To determine the contribution of Ca<sup>2+</sup>-influx vs Ca<sup>2+</sup>-release, we measured [Ca<sup>2+</sup>]<sub>i</sub> throughout 5 consecutive LSs in either normal or Ca<sup>2+</sup>-free ASW (0 mM Ca<sup>2+</sup>, 30 mM EGTA). Cells exposed to Ca<sup>2+</sup>-free ASW had a basal [Ca<sup>2+</sup>]<sub>i</sub> often below detection limits. Ca<sup>2+</sup>-free ASW abolished light-induced [Ca<sup>2+</sup>]<sub>i</sub> increases in all 7 cells tested. We next explored the role of voltage-gated Ca<sup>2+</sup> channels (VGCCs) to Ca<sup>2+</sup> influx with the use of cobalt, a VGCC blocker in B cells. Co<sup>2+</sup> did not affect either basal [Ca<sup>2+</sup>]<sub>i</sub> or light-induced [Ca<sup>2+</sup>]<sub>i</sub> increases (n = 5). To assess the contributions of the ER to light-induced [Ca<sup>2+</sup>]<sub>i</sub> changes, B cells were incubated in the ryanodine receptor blocker dantrolene. Dantrolene reduced the [Ca<sup>2+</sup>]<sub>i</sub> response by ~33% (n = 5), and also produced a progressive reduction in basal [Ca<sup>2+</sup>]<sub>i</sub> (~ 60%). Exposure of Ca<sup>2+</sup>-free ASW cells (n = 3) to thapsigargin (blocker of ER Ca<sup>2+</sup>-re-uptake) increased basal [Ca<sup>2+</sup>]<sub>i</sub>, consistent with store depletion. Collectively, our results indicate that [Ca<sup>2+</sup>]<sub>o</sub> is necessary for normal basal [Ca<sup>2+</sup>]<sub>i</sub> and for light-induced [Ca<sup>2+</sup>]<sub>i</sub> increases; but little Ca<sup>2+</sup> enters through VGCCs. This suggests that [Ca<sup>2+</sup>]<sub>o</sub> enters the cytosol via other routes or that the contribution of Ca<sup>2+</sup> through VGCCs is slight but serves to trigger Ca<sup>2+</sup>-induced Ca<sup>2+</sup>-release (CICR) from ER stores.

9. Ashley Chin-Baarstad (achinbaa@purdue.edu)

**SHOULD YOU EAT YOUR OFFSPRING BEFORE SOMEONE ELSE DOES? EFFECT OF AN EGG PREDATOR ON FILIAL CANNIBALISM IN THE SAND GOBY**

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<sup>2</sup>Department of Biological Sciences, Purdue University, W. Lafayette, IN

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<sup>4</sup>Environmental and Marine Biology, Åbo Akademi University

Costs and benefits of parental care are expected to affect filial cannibalism. One factor that tends to increase the costs and decrease the benefits of parental care is the presence of egg predators. In general the effect of egg predators on filial cannibalism is unknown. Here, we examine the effect of an egg predator on filial cannibalism in the sand goby. Males caring for eggs were exposed to three treatments: no egg predator, visual cues from an egg predator, and chemical and visual cues from an egg predator. We hypothesized that the perceived benefits of providing care in the presence of an egg predator would be relatively low, and we expected filial cannibalism to increase in the presence of the egg predator, especially when both chemical and visual predator cues were present, as this might represent a greater threat of predation. When both visual and chemical cues of the egg predator were present, whole-clutch cannibalism increased. Additionally, males in poorer condition and bigger males tended to exhibit less whole-clutch cannibalism than smaller males or males in better condition. There was no effect of the egg predator on partial-clutch cannibalism. However, males exhibiting partial-clutch cannibalism ate a smaller proportion of their eggs when the eggs were spawned by a relatively large female and when only a single female spawned. In general, our findings suggest that male sand gobies are sensitive to the costs and benefits of care and are more likely to terminate care when the expected benefits are relatively low.

10. Ann Cooper (asc1029@hotmail.com)

**THE EFFECTS OF ENHANCED SENSORY PERCEPTION TO LEARNING AND MEMORY RETENTION IN DROSOPHILA**

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<sup>2</sup>School of Biological Sciences and Technology, Chonnam National University, South Korea

Taste avoidance can be a learned behavior as well as an innate behavior. If an animal has few receptors for a stimulus where a stimulus might cause a mild repulsive reaction, an animal can be trained to avoid an environment. For this type of condition and with repeated training, animals show associative learning to an unconditioned stimulus (US) such as to light. However, animals that are extremely sensitive to the same stimulus may show a 1 trail learning and associate the US rapidly. The retention (memory) of the US would likely be stronger for the more sensitive animal. This is the topic that will be presented with the use of a genetically engineered strain of *Drosophila* which contains 3 inserted genes coding for the TRVP receptor (i.e. the capsaicin receptor). The larvae from this strain are extremely sensitive to capsaicin and will even die when left on agar tainted with 10uM pure capsaicin. The wild type control larvae show no aversion to the capsaicin and survive well eating the compound. Experiments are underway to train the over expressors of TRVP receptor with various concentrations of capsaicin to associate light or dark with the noxious stimulus. Retention of the learned associative response is also being examined. Funding: Ky Young Researchers, Univ. of Ky (A.S.C.).

11. Desiree Cossyleon (dcossyle@uemail.iu.edu)

**NEURONAL DYSFUNCTION IN THE CORTICOSTRIATAL PATHWAY UNDERLIES THE BEHAVIORAL PHENOTYPE IN THE R6/2 MOUSE MODEL OF HUNTINGTON'S DISEASE**

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Because Huntington's disease (HD) is a neurodegenerative disorder, much emphasis has been placed on cell death in striatum and cortex as the principal cause of cognitive and motor symptoms. However, recent work in transgenic mouse models of HD has indicated that neuronal dysfunction rather than cell loss gives rise to the HD behavioral phenotype. Motor behavior results from neuronal circuits of corticostriatal interactions. To investigate the properties of diseased neurons of the corticostriatal pathway, we implanted microwire electrodes unilaterally into striatum and overlying motor cortex (M1) of the R6/2 strain of mice transgenic for HD and recorded action potentials from each region simultaneously. This approach allows us to examine the neuropathogenesis at individual, populational, and interpopulational levels. At the individual neuronal level in M1, HD neurons displayed less bursting (temporal clusters of action potentials) than wildtype cells. The percentage of action potentials that occurred during bursts was higher in wildtype than in HD. However, bursts in HD cortex lasted longer than those of wildtype cortex. At the population level in both the cortical and striatal regions of R6/2 mice, neurons exhibited less correlated firing than wildtype counterparts. Additionally, communication between M1 and striatum is disrupted in that correlated firing within this pathway is decreased in R6/2. These differences demonstrate aberrant corticostriatal information processing and support the hypothesis that cell dysfunction, rather than cell loss, underlies the HD phenotype.

12. Kyle Craver (klcraver@ncsu.edu)

**VIDEO DISSECTION AND ANALYSIS OF AGGRESSIVE BEHAVIOR IN THE FRUIT FLY, *DROSOPHILA MELANOGASTER***

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Aggressive behavior is a fundamental survival trait that allows an individual to access and defend territory, food, mates, and offspring. It is a complex trait that is influenced by both the genetic background and the environment of an organism. Based on evaluation of 180 natural inbred lines of *Drosophila melanogaster* for aggressive behavior, we noted that many lines appeared to utilize line-specific "fighting styles." These fighting styles include variable suites of common aggressive encounters, such as kicks, chases, charges, boxing and wing threats. To investigate the hypothesis that fighting style is under genetic control, we conducted video-recorded aggression assays for 30 of the lines in order to quantify the frequency of each type of encounter for each line. Ten of the lines chosen for evaluation had high mean levels of aggression ( $62.7 \pm 3.0$  interactions per two-minute period; mean  $\pm$  SE), 10 had moderate aggression ( $23.7 \pm 2.0$ ) and 10 had low ( $5.7 \pm 0.7$ ) aggression. Lines were reared under constant environmental conditions, and 20 replicate, randomized vials were evaluated per line to quantify the frequencies of aggressive interactions. Differences among groups will be tested for statistical significance using a G-test. Heritabilities will be estimated and correlations for fighting style with other traits will be calculated. This research should further our understanding of the genetic basis of aggressive behavior in *Drosophila melanogaster*.

13. Jenelle Dorner (jdorner@indiana.edu)

**THE ROLE OF 17 $\beta$ -ESTRADIOL IN MODULATING STRIATAL ASCORBATE RELEASE IN A KNOCK-IN MOUSE MODEL OF HUNTINGTON'S DISEASE**

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A behavior related deficit in release of an antioxidant vitamin, ascorbate (Vitamin C; AA), has been observed in the striatum of symptomatic male mice expressing the human mutation for Huntington's disease (HD), an inherited, autosomal dominant condition caused by an expanded trinucleotide (CAG) repeat resulting in degeneration of the striatum and corticostriatal pathway. In a knock-in mouse model (KI) of HD, we showed that this striatal AA deficit is sex specific. Female KI mice did not exhibit the decrease in AA release that was observed in males. This is likely due to sex differences in activity of the gonadal steroid hormone, 17 $\beta$ -estradiol (E2). E2 modulates brain AA levels preventing AA loss associated with oxidative stress. E2 may prevent or delay AA loss in female HD mice. In this study we measured striatal ascorbate release in ovariectomized (OVX) KI and WT control mice treated with subcutaneous silastic capsules containing either E2 or placebo. We also monitored AA release across the estrous cycle in intact sham-treated KI and WT mice. Results show that E2 prevents AA loss in striatum of female OVX KI mice. Preliminary results in sham mice also suggest that AA release is greater during proestrous/estrous when E2 levels are highest. These findings likely account for the sex differences that we have observed in striatal AA release and behavior in KI mice. E2 likely plays a critical role in motor function and neuroprotection and may represent a therapy for neurodegenerative conditions.

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14. Shely Ferguson (asf@indiana.edu)

**Novel and Non-Novel Estrus Exposure Differentially Alter Real-Time Dopamine Release in the Nucleus Accumbens**

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Both rats and humans who are highly novelty-seeking are more likely to be addicted to drugs of abuse. Previous studies have found increased dopamine-release transients in the nucleus accumbens following the administration of drugs of abuse, implicating dopamine in drug addiction. To assess the link between dopamine efflux and exposure to novelty, fast-scan cyclic voltammetry in the nucleus accumbens of six male Sprague-Dawley rats was combined with exposure to novel and non-novel estrus. Cyclic voltammograms, confirmed by in vitro testing, showed that exposure to novel, but not, non-novel estrus increased dopamine release for periods of 5 to 10 seconds. The response occurred within 3 seconds following approach to the stimulus. Collectively, these results implicate dopamine as a modulator in the response to novel sexual stimuli in a similar way to a drug response in the mesocorticolimbic circuit. Research focusing on individual differences in dopamine release during novelty and drug exposure may be an important step in engineering effective treatments to both treat and prevent drug addiction in the future.

15. Tom Gaither (tgaither@indiana.edu)

**ENHANCEMENT OF GLUTAMATE UPTAKE REVERSES DYSFUNCTIONAL CORTICOSTRIATAL-DEPENDENT ASCORBATE RELEASE IN HUNTINGTON'S DISEASE**

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The striatum is a key target of Huntington's disease (HD), an autosomal dominant condition characterized by progressive loss of motor control and cognitive decline. Glutamate (GLU), a potentially excitotoxic amino acid released by corticostriatal afferents, and ascorbate (vitamin C; AA) appear to play critical roles in HD pathogenesis. For example, the transporter primarily responsible for GLU uptake (GLT1) is dysfunctional in striatum of HD mice, leading to deficient clearance of synaptic GLU. Consistent with these findings is that striatal AA release, which is directly linked to the degree of GLU uptake and corticostriatal excitability, is diminished in HD. Interestingly, treatment with ceftriaxone, a  $\beta$ -lactam antibiotic that upregulates the functional expression of GLT1, reverses the GLU uptake deficit and markedly attenuates the HD phenotype in R6/2 mice. Our aim, therefore, was to test the hypothesis that increased GLU uptake via ceftriaxone treatment will reverse deficient striatal AA release in the R6/2 mouse. Slow-scan cyclic voltammetry coupled with cortical stimulation in ceftriaxone-treated R6/2 mice and wild-type (WT) littermates was used to monitor corticostriatal-dependent release of AA. Cortical stimulation resulted in an increased striatal AA in both WT and R6/2 mice. AA concentrations, however, were lower in R6/2 mice both before and after cortical stimulation, and release of AA in response to stimulation was diminished in R6/2 compared to WT. Ceftriaxone treatment, which results in increased GLU uptake, enhanced the release of striatal AA in both WT and R6/2 mice. In fact, the level of AA release in R6/2 mice treated with ceftriaxone was similar to levels in vehicle-treated WTs. Our data not only support the role of glutamate uptake in striatal AA release, but suggest that ceftriaxone can be used to enhance striatal AA in R6/2 mice.

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16. Nicholas Garcia (nwgarcia@indiana.edu)

**INSULIN AFFECTS IMMUNE RESPONSES DIFFERENTIALLY IN REPRODUCTIVE AND NON-REPRODUCTIVE SIBERIAN HAMSTERS (*PHODOPUS SUNGORUS*)**

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Many animals living in temperate clines experience relatively predictable seasonal changes in environmental conditions and utilize photoperiodic cues to "predict" these environmental changes. Most non-tropical mammals must re-allocate finite energy reserves from systems not critical to immediate survival (e.g., immunity) to systems critical to immediate survival (e.g., thermoregulation) and rely environmental cues (i.e., photoperiod) to trigger these adaptations. The seasonal attenuation of immune function is likely regulated by endocrine signals indicating the amount of energy available to the animal. For example, recent research has demonstrated changes in immune functioning in response to the adipose hormone leptin. In addition, the pancreatic hormone insulin is also released in response to elevated blood glucose levels and may indicate readily available energy to the central nervous system. The aim of the present study was to determine the role of insulin in signaling energy status and investment in immune function in animals held under varying photoperiod conditions. To this end, exogenous insulin was administered to reproductive long-day (16:8 L:D) and non-reproductive short-day (8:16 L:D) housed Siberian hamsters (*Phodopus sungorus*). Hamsters were then challenged with an innocuous antigen, keyhole limpet hemocyanin, and immune response was measured. Insulin treatment significantly enhanced immune response in short-day but not long-day hamsters. These data suggest a role for insulin as a neuroendocrine signal integrating seasonal energetic changes and immune responses.

17. Stephanie Gorski (slgorski@ncsu.edu)

### **EVOLUTION OF HOST RECOGNITION IN PEST MOTHS**

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Understanding how herbivorous insects choose their host plants will lead to a better understanding of insect evolution, speciation, and diversification, and has practical application in agricultural pest management as well. Little is known about the genetic basis for differences between generalist and specialist herbivore insects and their ability to recognize host plants. The moth species *Heliothis subflexa* is a specialist that feeds only on plants in the genus *Physalis*, while the closely related *Heliothis virescens*, a generalist, feeds on over 14 plant families. The ability to hybridize these two species in the laboratory and the distinct differences in their host ranges provide a unique opportunity to examine the genetic basis of differences in oviposition behavior between generalist and specialist insects. *H. subflexa* and *H. virescens* were hybridized, and hybrids were backcrossed to each of the parent species. This resulted in backcrossed individuals segregating for host range genes from both species. These backcrossed individuals, F1 hybrids, and the two parent species were released in large outdoor tents containing tobacco (a host of *H. virescens*) and *Physalis* plants, and oviposition behavior was recorded. In general, moths backcrossed with *H. subflexa* oviposited on *Physalis* while *H. virescens* backcrosses oviposited on tobacco. However, variations in oviposition and other behavior patterns did occur, and results will be discussed in the context of the genetic basis of differences in host use.

18. Tiphani Grimes (tgrimes4@student.gsu.edu)

### **THE SEA HARE *APLYSIA CALIFORNICA* RELEASES APLYSIOVIOLIN AS A MAJOR DETERRENT IN DEFENSIVE INK SECRETION**

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Sea hares, *Aplysia californica*, release purple ink when attacked by predators. Previous results showed that ink is a chemical deterrent against many predators, and that aplysiaviolin and its precursor, phycoerythrobilin, are components of ink that are equally effective deterrents against predatory blue crabs, *Callinectes sapidus*. In my study, I asked three questions. 1. What is the effective concentration of aplysiaviolin against blue crabs? 2. Is there a synergistic or additive effect between the components in ink? 3. Are compounds structurally related to aplysiaviolin also deterrents? To identify effective concentrations of aplysiaviolin, ink was separated according to its polarity into four fractions: aplysiaviolin, phycoerythrobilin, a high polar fraction, and a fraction containing all other parts. These fractions were added individually or in combinations to food and tested in a feeding bioassay against crabs. Crabs rejected food containing aplysiaviolin at a concentration 10-100% of that in full-strength ink, but they ate food containing each of the other individual fractions at these concentrations. A mixture of all fractions that were individually inactive yielded an active mixture, indicating additive or synergistic effects. Bilirubin, a linear tetrapyrrole structurally similar to aplysiaviolin and phycoerythrobilin but not present in ink, is not significantly deterrent against crabs, showing that not all linear tetrapyrroles are equally effective. I conclude that aplysiaviolin is the major feeding deterrent in ink against blue crabs, and that sea hares may convert diet-derived phycoerythrobilin into aplysiaviolin to improve its storage in ink, by making it more stable and/or less polar. Supported by NSF IBN-0614685.

19. Jennifer Hackney (hackneyj@indiana.edu)

### **INJURY INDUCED DEVELOPMENTAL DELAY IN DROSOPHILA**

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In humans, severe injury, infection and disease can result in disruptions in development (delayed onset of puberty/fetal development defects). Developmental delays triggered by injury are often associated with changes in steroid hormone titers however the pathway by which this occurs remains largely unknown. Similarly, in insects injury to specific tissues can result in a global developmental delay (prolonged larval/pupal stages). Mechanisms underlying this response are poorly understood but probably involve regulating synthesis of ecdysone, a steroid hormone required for developmental transitions in insects. I use *Drosophila* as a model to examine the pathway by which injury to specific tissues triggers a global developmental delay. Mechanical injury to the larval epidermis results in a developmental delay associated with decreased expression of the Halloween genes, which encode enzymes required for ecdysone synthesis. In addition, targeted expression of a dominant negative form of the ecdysone receptor (DN-EcR) disrupts development of specific larval tissues. Animals expressing DN-EcR die just after pupariation but tissues dissected from these animals can be induced to develop upon ecdysone addition suggesting that the developmental arrest results from reduced ecdysone titer in the hemolymph. In support of this, Halloween gene expression is reduced in DN-EcR animals. Finally, in the adult, the ovaries are the major ecdysteroidogenic tissue. Injury to adult females triggers follicle degradation and reduced levels of Halloween gene expression, consistent with the idea that regulating the ecdysone titer via decreased expression of Halloween genes may be a common mechanism for triggering developmental delays in response to injury.

20. Maxwell Hennings (maxhennings@gmail.com)

### **AN INVESTIGATION OF THE TRITONE PARADOX IN THE AUDITORY PERCEPTION OF RATS AND PIGEONS**

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The Tritone paradox occurs when two tones are presented, each tone consisting of a set of octave-related components, which are separated by a half-octave (Deutsch & Kuyper 1987). This phenomenon creates an illusion of pitch ambiguity from which listeners report conflicting answers when asked to discriminate pairs as either ascending or descending (Deutsch & Kuyper 1987). Stimuli were constructed using 12 notes (C, C#, D, D#, E, F, F#, G, G#, A, A#, B) paired together into various combinations of ascending (e.g., C-C#), descending (e.g., C#-C) and ambiguous (e.g., C-F#) tone pairings. Pigeons will be trained to discriminate between ascending and descending tone pairings by pecking one of two keys. Similarly, rats will be trained to discriminate between ascending and descending tone pairings by pressing one of two levers. Research will be conducted over 3 different phases: training, a novel unambiguous transfer phase, and a novel ambiguous transfer phase. Each phase will introduce novel tone pairings with Tritone tone pairings being introduced during the final transfer phase of the experiment. The goal of this research project is to comparatively explore the Tritone paradox across species in order to better understand what similarities and differences exist between various species auditory perceptual abilities.

21. Jacqueline Ho (jmho@indiana.edu)

### **ENDOCANNABINOIDS REGULATE ENERGY BALANCE IN SIBERIAN HAMSTERS**

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Siberian hamsters fluctuate in adiposity with seasonal changes in food intake and body mass, losing ~30% of their body mass in short winter-like photoperiods and regaining this decrement upon return to long summer-like photoperiods. These high and low energy states parallel human states of obesity and leanness, and transitions between long-term energy states characterize development and life-history in many organisms. The mechanisms responsible for changes in Siberian hamster adiposity are not well understood; gene expression profiles of “classic” regulatory peptides cannot fully explain these changes. The endocannabinoid (EC) system affects appetite and energy balance, and empirical data support the involvement of hypothalamic CB1 receptors in cannabinoid-induced feeding. We tested whether differences in EC signaling contribute to seasonal changes in Siberian hamster adiposity. Specifically, we transferred hamsters from long-day photoperiod (LD) to short-day photoperiod (SD) and compared levels of central CB1 receptors to long-day controls at 0, 2, 6, and 12 weeks. Effects of CB1 stimulation or blockade on food intake and body mass were also examined in SD- and LD-acclimated animals by administering daily i.p. injections of a CB1 agonist or antagonist for five days. Immunocytochemical analysis revealed CB1 staining in several brain regions including the hypothalamus; ongoing analyses will determine seasonal and sex differences in CB1 labeling. Blockade of CB1 reduced food intake in LD and SD hamsters. Collectively, these findings suggest that ECs affect energy balance and may be involved in regulating photoperiodic changes in adiposity.

22. Winnie Ho (wwho@indiana.edu)

### **DIVERGENCE IN THE ENDOCRINE REGULATION OF SEXUALLY DIMORPHIC BEHAVIORS IN GEOGRAPHICALLY ISOLATED POPULATIONS OF WEAKLY-ELECTRIC FISH**

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Sexual dimorphism is a prominent feature of many animal communication behaviors. The black ghost knifefish (*Apteronotus albifrons*) produces sexually dimorphic electric organ discharges (EODs) that are characterized by particular frequencies (EODf). During social interactions, fish can rapidly modulate the EODf to produce “chirp” signals. The magnitude of sexual dimorphism in EODf and chirping varies dramatically at the population level. To understand the evolutionary and physiological origins of variation in sexually dimorphic behavior, we (1) recorded communication signals and sequenced genes from populations in the Amazon and Orinoco rivers to map behavioral variation onto genetic variation, and (2) treated fish with gonadal steroids to assess how endocrine mechanisms contribute to variation in sexually dimorphic behavior. Populations from the Amazon and Orinoco were genetically and behaviorally distinct. Populations from the Orinoco showed marked sexual dimorphism, while populations from the Amazon did not. We examined EODf and chirping behavior in one population from each drainage, before and after treatment with gonadal steroids. 11-ketotestosterone (11-kT) and estradiol (E2), administered orally, increased plasma steroid levels. Baseline levels of 11-kT and E2 were not significantly different between populations. EOD behaviors in both populations responded to steroid treatment; however, populations differed in the magnitude of their behavioral response, indicating that population differences in sexually dimorphic behaviors may be mediated by population differences in steroid responsiveness. These results suggest that geographic isolation may lead to divergence in the endocrine pathways that regulate reproductive behavior, and could be important in the early stages of speciation in weakly-electric fish.

23. Abby Howenstein (ahowenst@indiana.edu)

**ACOUSTIC TRAUMA ALTERS SEROTONERGIC PROJECTIONS IN THE INFERIOR COLLIULUS**

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Acoustic trauma can affect all levels of organization of the brain. However the exact mechanism following the damage is largely unknown. It is suspected that the neuromodulator serotonin (5-HT) could be a factor in central auditory regulation following the acoustic trauma. Here we show a small but significant difference in the number of serotonin fibers between the hemisphere of the brain affected by acoustic trauma and the control hemisphere. One ear of each CBA/J mouse was blocked with petroleum jelly, leaving the other ear exposed. The acoustic trauma consisted of an 8 kHz pure tone at 113 dB SPL for 6 hours. Trauma was verified using an auditory brainstem response (ABR) and then the mouse was immediately perfused. An antibody stain was performed to stain for the serotonin reuptake transporter (SERT). StereoInvestigator software was employed in order to calculate the density of serotonin fibers in the inferior colliculus of the slices of the brain. Each time a fiber crossed one of the spaceballs, or spherical projections centered on a grid, that fiber was marked and density measurements were performed based on the numbers from four to eight sections of the IC. A small difference was found between the hemispheres of the unilaterally traumatized mice suggesting a link between fiber density and acoustic trauma. It is also possible that the concentration of serotonin in the traumatized area would show a greater significance than the serotonin fibers.

24. Jeeha Hussain (wahussai@indiana.edu)

**NEURONAL DYSFUNCTION IN THE CORTICOSTRIATAL PATHWAY UNDERLIES THE BEHAVIORAL PHENOTYPE IN THE R6/2 MOUSE MODEL OF HUNTINGTON'S DISEASE**

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Because Huntington's disease (HD) is a neurodegenerative disorder, much emphasis has been placed on cell death in striatum and cortex as the principal cause of cognitive and motor symptoms. However, recent work in transgenic mouse models of HD has indicated that neuronal dysfunction rather than cell loss gives rise to the HD behavioral phenotype. Motor behavior results from neuronal circuits of corticostriatal interactions. To investigate the properties of diseased neurons of the corticostriatal pathway, we implanted microwire electrodes unilaterally into striatum and overlying motor cortex (M1) of the R6/2 strain of mice transgenic for HD and recorded action potentials from each region simultaneously. This approach allows us to examine the neuropathogenesis at individual, populational, and interpopulational levels. At the individual neuronal level in M1, HD neurons displayed less bursting (temporal clusters of action potentials) than wildtype cells. The percentage of action potentials that occurred during bursts was higher in wildtype than in HD. However, bursts in HD cortex lasted longer than those of wildtype cortex. At the population level in both the cortical and striatal regions of R6/2 mice, neurons exhibited less correlated firing than wildtype counterparts. Additionally, communication between M1 and striatum is disrupted in that correlated firing within this pathway is decreased in R6/2. These differences demonstrate aberrant corticostriatal information processing and support the hypothesis that cell dysfunction, rather than cell loss, underlies the HD phenotype.

25. Alan Kennedy (Alan.J.Kennedy@usace.army.mil)

**USE OF BEHAVIORAL CUES TO CONTROL THE ADHESION OF TERRESTRIAL  
INVASIVE SPECIES**

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Much research has been conducted to prevent aquatic nuisance species from adhering to surfaces. Technologies have historically used environmentally persistent chemicals (e.g., TBT, Cu) in paints that are detrimental to non-target species, resulting in legacy contamination. Research is needed to understand the behavioral cues organisms use while selecting surfaces to which they attach. Understanding these cues will lead to more environmentally-friendly control approaches. Less research has focused on controlling adhesion of terrestrial pests. Terrestrial gastropod snails are voracious herbivores that can destroy agricultural crops. They also estivate on surfaces (e.g., military vehicles, containers) which facilitates their transport to new geographical regions where they can become invasive species. Our work investigates the behavioral responses of the terrestrial gastropod, *Otala lactea*, to unique surface properties. Short-term (8-min) behavior was assessed using the EthoVision® digital tracking system (Noldus Information Technology) while longer-term (48-h) experiments were conducted by allowing gastropods to select surfaces for estivation. The novel surfaces employed in our study had various levels of hydrophobicity (measured as contact angle), surface roughness (AFM), and topographical features (SEM). Additionally, we are investigating the surface release of triethylsilanol, which rapidly degrades in the environment. Preliminary results indicated that hydrophobic surfaces can induce erratic locomotion behavior and decrease adhesion strength (kPa). Micro-scale patterned topographical features can deter gastropod estivation (up to an 80% reduction relative to reference surfaces). This technology development promises to save time and money allocated to physical removal of organisms and future damages caused by transported invasive species.

26. James Klatt (jklatt@indiana.edu)

**VASOPRESSIN-LIKE RECEPTORS AFFECT NEST BUILDING IN A MAMMALIAN PATTERN IN  
MALE AND FEMALE ZEBRA FINCHES**

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Neuroendocrine mechanisms of parental behavior in nonmammalian vertebrates are largely unknown. Although nonapeptides (the vasopressin- and oxytocin-like neuropeptides) are good candidates, they have yet to be detailed in this context; however, our recent research in zebra finches, *Taeniopygia guttata*, suggests that oxytocin-like receptors are essential for nesting behavior only in females and are not essential for other aspects of parental care. Using a novel vasopressin V1a antagonist that crosses the blood-brain barrier, we now show that V1a-like receptors are required for normal nesting behavior in both males and females. Further, we show no effect of the vasopressin V1a antagonist on parental behaviors involved in egg incubation. These data are very similar to mammals; V1a receptors are essential for parental care in both sexes of mammals. However, the specific behaviors regulated by avian nonapeptides may not be as clear. We are currently examining the function of vasopressin-like receptors in chick care.

27. Teal Larsen (mllarsen@indiana.edu)

**PLAY BEHAVIOR IN THREE SYMPATRIC SPECIES: MANTLED HOWLER MONKEYS (*ALOUATTA PALLIATA*), WHITE-FACED CAPUCHIN MONKEYS (*CEBUS CAPUCINUS*), AND BLACK-HANDED SPIDER MONKEYS (*ATELES GEOFFROYI*)**

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For many mammals and especially for primates, play behavior may be important in developing fundamental social skills and for improving motor skills. This study explored differences in the level of play between the three sympatric subject species: mantled howler monkeys (*Alouatta palliata*), white-faced capuchin monkeys (*Cebus capucinus*), and black-handed spider monkeys (*Ateles geoffroyi*). Contextual data of play at the troop level was examined and analyzed, as were the differences between age classes and the amount of play observed. To address behavioral correlations with the aforementioned variables, behavioral observations were collected using instantaneous focal sampling at one minute intervals reaching a collective total of 50.07 hours. All observations were carried out at El Zota Biological Field Station and Puerto Viejo, Costa Rica. Analysis of data revealed that there was a notable difference in the amount of play exhibited between species, mantled howlers engaged in less play than white-faced capuchins and black-handed spider monkeys. Play was more likely to occur during group resting. Lastly, play was most common among the juvenile age class.

28. Kathryn Lenz (kmlenz@indiana.edu)

**MATERNAL CARE EFFECTS ON MALE COPULATORY BEHAVIOR AND SNB MOTONEURONS: THE MEDIATING ROLE OF SPINAL OXYTOCIN**

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Early maternal care shapes the sex behavior of male rats, with reductions in maternal licking of the perineum producing adult copulatory deficits. Maternal care also influences the spinal nucleus of the bulbocavernosus (SNB), a sexually dimorphic motor nucleus in the lumbosacral spinal cord that controls penile reflexes. Reducing maternal licking produces decreased adult SNB motoneuron number, size and dendritic length in offspring, especially in the rostral portion of the nucleus. Our previous research has investigated the role of tactile stimulation in producing these effects, particularly the mediating role of primary sensory afferents from the perineal skin and their activation. We have begun to investigate whether spinal oxytocin signaling also plays a role in maternal effects on SNB motoneuron development. Previous research has shown that oxytocin afferents from the paraventricular nucleus of the hypothalamus (PVN) innervate the lumbosacral spinal cord, and somatosensory stimulation has been shown to increase central oxytocin levels. We therefore tested if licking-like tactile stimulation activates oxytocinergic neurons in the PVN and whether this stimulation increases spinal oxytocin levels. Using immunofluorescence, we found that perineal stroking of neonates induces Fos expression in oxytocinergic neurons of the PVN. Using enzyme immunoassay, we assessed whether perineal stroking produces an acute increase in spinal oxytocin levels. Relative to undisturbed control pups and handled pups, stroked pups showed transiently increased oxytocin levels in the lumbosacral portion of the spinal cord. Together, these data suggest that supraspinal oxytocin signaling may possibly contribute to maternal effects on the masculinization of the SNB.

29. Kimberly Long (kimlong@indiana.edu)

### **PHOTOPERIOD AND SEX DIFFERENCES IN RESPONSE TO EXOGENOUS KISSPEPTIN**

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To increase reproductive success, seasonally breeding animals coordinate reproduction to coincide with optimal environmental conditions (i.e. summer) and down-regulate reproduction during winter to maximize individual survival. In laboratory settings, photoperiod acts as the primary environmental cue regulating reproduction, with short days signaling winter conditions and long days summer conditions. The neuropeptide kisspeptin serves as a key biochemical regulator of reproduction, controlling the timing of puberty by acting directly on the hypothalamo-pituitary-gonadal axis. In seasonal animals, hypothalamic kisspeptin expression is modified in response to changing photoperiods. Further, injections of kisspeptin activate the HPG axis in reproductive males and females, as well as non-reproductive males; similar injections in non-reproductive females, however, fail to activate HPG. Here we investigated the effects of kisspeptin on the HPG axis in Siberian hamsters (*Phodopus sungorus*). Male and female hamsters were injected with a range of kisspeptin doses and reproductive hormones were assessed; reproductive status was also manipulated by exposing hamsters to either long or short days. Based on our previous results, we predict that females will show altered sensitivity to kisspeptin at intermediate doses compared with males, and that this result will be driven by a marked decrease in the effects of kisspeptin in non-reproductive short-day females. Collectively, the results of the present study will help shed light on the neuroendocrine mechanisms controlling reproduction in this and other species.

30. Sean Menke (sean\_menke@ncsu.edu)

### **PHYLOGEOGRAPHY OF THE ODOROUS HOUSE ANT TAPINOMA SESSILE**

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Studies of introduced species are often unable to eliminate alternative hypotheses explaining what makes a successfully invader because of both the vast distances and differences between native and invasive ranges. Human modification to the environment in the forms of urban sprawl and agricultural have dramatically transformed the landscape. Some native species have moved into these altered landscapes from adjacent natural areas, thereby becoming "native invasives". The odorous house ant (OHA) (*Tapinoma sessile*) has been recognized as a urban structural pest for over 100 years, is the most widespread native ant and pest ant in the US, and it is rapidly spreading its range as an urban pest. Pest populations of the OHA share several life history traits (e.g. dominant behavior, unicoloniality, and polygyny) with many of the most destructive invasive ant species. Interestingly, populations of the OHA in natural environments show genetic variation across their range at the mitochondrial Cytochrome Oxidase I (COI) gene and different life history traits including variation in dominance, colony size, and colony structure. Here were determine, (1) the genetic differences of the OHA across its range and between urban and natural environments, and (2) the source environment for the urban pest populations using the COI gene. Our results establish the use of the OHA and more generally other native pest species as a new model system to understand the mechanisms underling the success of introduced species. Using these "native invasive" systems we can directly test and eliminate the alternative hypotheses that have been proposed to explain what makes a successful invasive species.

31. Leigh Miles (lamiles@emory.edu)

**CORTICOTROPIN-RELEASING FACTOR (CRF) TYPE 1 RECEPTORS IN THE BED NUCLEUS OF THE STRIA TERMINALIS MEDIATE LONG- (MINUTES) BUT NOT SHORT- (SECONDS) DURATION STARTLE INCREASES TO SHOCK-PREDICTING CUES**

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Oral administration of the CRF-R1 antagonist GSK008 disrupts sustained startle increases produced by intra-ventricular CRF infusions and those that occur when rats are tested in an illuminated environment (innate anxiety response), but not startle increases produced by short-duration (i.e., 3.7-sec) lights that predict shock. These and other results suggest a preferential role of CRF in sustained (vs. short) or innate (vs. conditioned) fear reactions or in fear reactions to vague (vs. imminent, well-defined) threats. To evaluate these three alternatives, the effects of orally administered GSK008 were evaluated using several different fear conditioning and fear potentiated startle (FPS) test procedures. Experiment 1, rats received variable-duration (3-sec to 8-min) 60-Hz clicker stimuli with co-terminating footshock and were later tested for FPS to 8-min clicker presentations (i.e. long, conditioned, unpredictable). Experiment 2, rats received 3.7-sec clicker stimuli and co-terminating footshock, and were later tested for FPS to 3.7-sec clicker presentations (i.e., short, conditioned, predictable). Experiment 3, rats were trained with variable duration clicker stimuli, but were tested with 3.7-sec clicker presentations (short, conditioned, unpredictable). FPS to 8-min (Exp. 1) but not 3.7-sec (Exp.'s 2 and 3) CS presentations was blocked by GSK008. Together, these results indicate that CRF mediates long-duration fear responses irrespective of conditioning or predictability. Previous findings indicate a similar role for the bed nucleus of the stria terminalis (BNST) in mediating long-duration fear responses. Therefore, we next compared the effect of intra-BNST GSK008 infusions on FPS to 3.7-sec vs. 8-min CS presentations. As with oral infusions, intra-BNST GSK008 blocked FPS to the 8-min but not 3.7-sec shock-associated CS.

32. Benjamin Miller (benmille@indiana.edu)

**DYSREGULATED STRIATAL INFORMATION PROCESSING IN A TRANSGENIC RAT MODEL OF HUNTINGTON'S DISEASE**

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Medium spiny neurons (MSNs) in striatum are implicated in the behavioral phenotype of Huntington's disease (HD), an incurable autosomal dominant condition characterized by cognitive and motor decline. Although the loss of these cells may play a role in the symptoms of HD, recent evidence suggests that the onset and progression of the behavioral phenotype is likely caused by deficits in corticostriatal information processing that precede cell death. Mice that model HD, for example, show behavioral symptoms long before significant cell loss. These behavioral changes, moreover, are accompanied by changes in the intrinsic properties of MSNs. We have recently shown that HD results in a marked alteration of MSN spike patterns in two HD mouse models. Interestingly, these two mouse models recapitulate HD either severely (R6/2 model) or moderately (KI model) and their genetic construct is vastly different than the human disorder. Our aim was to extend these findings in a rat model of HD (tgHD) that mimics more closely the genetic construct and behavioral phenotype of human HD. We found MSN spike patterns in the tgHD rats mirrored our findings in the HD mouse models. Like MSNs in the HD mouse models, coincident bursting, which measures bursts that co-occur between two neurons, was decreased in tgHD compared to wild-type (WT) rats. Similarly, correlated firing, which is a prominent feature of WT MSNs, was drastically reduced in tgHD rats. These data support our previous findings and suggest that altered MSN spike activity is a cardinal feature of HD.

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33. Jorge Morales (jfmorale@indiana.edu)

**THE PHILOSOPHER ON THE MERRY-GO-ROUND: A CASE OF MISUSE OF THE ANIMAL PSYCHOLOGY LITERATURE**

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Nonconceptualist philosophers argue that thanks to evolutionary continuities between animals and humans, the nonconceptual contents used by nonhuman animals should have remained throughout the evolutionary development of our species as a basic trait of our minds too. Nevertheless, as the research in animal psychology shows us, most of the mental abilities we share with other animals are present in them in a less sophisticated way. I will use the special case of Theory of Mind to show how, despite the recent discovery of it in some primates, it is present in a more limited way: it is restricted to context and to a perceptual level of description. Usually, the possession of language and (abstract, higher-order, linguistic, etc.) concepts is championed as the main explanation of the exponential difference between humans and other animals. Even those philosophers and scientists that refrain from postulating language as the main cause of human dexterity end up using—willingly or not—some form of language-based argument. My claim is that arguing that nonhuman animals have nonconceptual contents in order to defend the presence of these in humans as the nonconceptualist attempts, would still leave open the question of how these nonconceptual contents are used by linguistic creatures. But this would bring the nonconceptualist to the exact point where she started: trying to show that there are mental contents that can appear in beliefs and/or in reasoning processes that are not conceptual or linguistic.

34. Fernando Munoz (munozf@uemail.iu.edu)

**INFLUENCE OF ANDROGENS METABOLITES ON SECONDARY DENDRITIC ATROPHY**

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Motoneuron loss is a serious medical problem where progression can lead to loss of motor function and can even lead to death. It has been shown that testosterone attenuates secondary atrophy within the sexually dimorphic, highly androgen sensitive SNB and the more typical motoneurons that innervate the quadriceps muscles. Because testosterone can be metabolized into both androgenic and estrogenic hormones, in this study we examined whether the protective effects of testosterone (T) could be mediated via its metabolites. Saporin was injected into the left vastus medialis to selectively kill the innervating motoneurons. Coincidentally with the injection, estradiol (E) or dihydrotestosterone (DHT) implants were placed in the rats. After four weeks, the motoneurons innervating the ipsilateral vastus lateralis muscle were labeled with BHRP. Results show that motoneurons innervating the vastus lateralis experienced reductions in dendritic length and somal size. Like treatment with T, E and DHT were able to attenuate secondary atrophy in the quadriceps motoneurons. The present experiment has shown that E and DHT have the same ability as T to attenuate secondary atrophy.

35. Saúl Nava (snava@indiana.edu)

**SEX-SPECIFIC VISUAL PERFORMANCE AND POPULATION DIVERGENCE IN *SCELOPORUS UNDULATUS* LIZARDS AT THE WHITE SANDS ECOTONE.**

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In animal communication, the sensory drive model predicts that visual signals evolve to match the visual abilities of receivers, which in turn are shaped by the physical conditions of the environment. Thus, when populations of animals live in habitats that differ in visual conditions, the visual systems of individuals from those populations may diverge, and in turn guide the coevolution of signals and visual performance. This coevolution may also depend on the strength of differential selection on the sexes, e.g., if sexual selection acts strongly and independently on both sexes, phenotypic evolution can be accelerated. Here, I tested for population and sex differences in visual performance in the sexually dimorphic *Sceloporus undulatus* lizards that have evolved adaptive dorsal coloration in three extremely divergent habitat types (white sand dunes, black lava rocks, and desert scrub). I show that morphs from the three habitats differ in spectral sensitivity to the blue color exhibited by males. I also find that males and females differ in their ability to detect the blue coloration. Specific data and results will be presented. These findings suggest that visual performance may evolve quickly and diverge between the sexes and that the sensory drive process may be best described as the repeated co-evolution between signals and receiver sensory systems.

36. Mark Nolen (mtnolen@purdue.edu)

**TUFTED TITMOUSE RESPONSE TO CAROLINA CHICKADEE MOBBING AND CONTACT CALLS: EFFECTS OF PLAYBACK AND HETEROSPECIFIC SOCIAL CONTEXT**

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The general importance of heterospecific vocalizations in the initiation of mixed-species flocking and mobbing behaviors is unknown. Previous work has suggested that heterospecific vocalizations facilitate these behaviors, but experimental evidence from playbacks is scarce. We conducted playback experiments to test the hypothesis that vocalizations of Carolina chickadees (*Poecile carolinensis*) facilitate the frequent association between this species and the tufted titmouse (*Baeolophus bicolor*). Playback treatments consisted of a contact call and a mobbing call. Nine adult male titmice were radio-tagged and each individual received at least one replicate of a contact call and a mobbing call playback. Titmice responded with stronger movements during mobbing call playback. Titmice also responded with stronger movements and showed an increase in vocal rate during playback when fewer chickadees were present. However, overall weak responses to our playbacks suggest that the 'Chick-A-Dee' calls of Carolina chickadees may only attract titmice if the calling rate is high enough to indicate a substantial amount of predation risk. Additional experiments have shown that titmice do respond strongly when chickadee mobbing call chorus playback is used to represent higher predation risk.

37. Dustin Reichard (dgreicha@indiana.edu)

**SO-CAL ATTITUDE MEETS HUMBLE APPALACHIA: THE RESPONSE OF MALE DARK-EYED JUNCOS (*JUNCO HYEMALIS*) TO LOCAL AND FOREIGN SONG**

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Vocalizations, such as bird song, can be an integral part of courtship and territory defense. In the oscine songbirds, songs are culturally transmitted, making them subject to substantial change between generations and across geographic areas. This inherent variation in song can be beneficial in adapting to new environments, but it can also create barriers to gene flow. The Dark-eyed Junco (*Junco hyemalis*) is an interesting case of within-species diversity in morphology and distribution as five distinct subspecies are thought to have rapidly diversified over the past 10,000 years. Little is known, however, about song diversity between these subspecies or whether song has a role in facilitating the junco's rapid diversification. We quantified differences in song between two subspecies of junco: *J. h. thurberi* from California and *J. h. carolinensis* from Virginia. We then simulated territorial intrusions to *J. h. carolinensis* males using local con-subspecific songs and foreign hetero-subspecific songs from *J. h. thurberi* to determine whether subspecific differences in song were meaningful to territorial males. The songs of these two subspecies did not differ in any of the frequency parameters measured, however they did differ significantly in trill rate and the duration of pauses between song bouts. *J. h. carolinensis* males did not differ detectably in their response to local song types and foreign song types, indicating that males did not differentiate between con- and hetero-subspecific song stimuli. Our results suggest that song is surprisingly conserved between these two subspecies, despite striking differences in their plumage and morphology.

38. Rebecca Rice (rejrice@indiana.edu)

**VARIATION IN THE SEASONAL BODY FAT PROFILES OF TWO RECENTLY DIVERGED SONGBIRD (*JUNCO HYEMALIS*) POPULATIONS FOLLOWING A UNIQUE COLONIZATION EVENT.**

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Seasonal changes in body fat associated with wintering and migrating have been characterized within many species; however few studies have examined how ecological factors may shape divergence in seasonal physiology among populations or taxa. In this study we evaluated seasonal changes in fat in a common garden study of captive birds from two recently diverged dark-eyed junco (*Junco hyemalis*) populations, following one population's colonization of a novel environment. In the early 1980s, a population of juncos (typically a montane forest-breeding species) colonized the coastal urban environment of San Diego, California. Several behavioral and morphological differences between the colonist and ancestral-range populations have been characterized, some of which are attributed to post-colonization rapid evolution. Juncos will commonly show variation in weight loss and fattening in accordance with seasonal breeding and migration. Since juncos from the colonist population have ceased migrating, and have nearly doubled the length of their breeding season, we predicted that any population differences in seasonal fattening would persist in a common garden study, which would provide evidence for rapid evolutionary change. Preliminary data indicate the coastal non-migratory population exhibits the same seasonal pattern of fattening and fat loss as the mountain population. However, the magnitude of weight fluctuation is much lower for the coastal population. Thus, these data support both evolutionary change and evolutionary conservation post-colonization. Future studies will characterize migratory restlessness behavior in both populations to better evaluate whether fat differences may be attributed to differences in migratory behavior, wintering climate, or both.

39. Alejandra Rossi (alrossi@indiana.edu)

### **INTENTIONAL BEHAVIOR IN DOG-HUMAN COMMUNICATION**

A. Rossi and C. Allen

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In this paper we investigate under what conditions showing behavior (transferring of information in an active way from the dog to the owner) emerges in dogs. In order to study this, the dogs were observed under different experimental conditions where the presence of the humans and/or hidden food was manipulated. We also analyzed the relation between the owner- dog relationship and the way the dog behaves in the communication task by analyzing video tapes of free playing time. We hypothesize that if the owner-dog relationship is more interactive, the dogs will tend to do more showing behavior than if the relation is less interactive.

40. Mayté Ruiz (mayruiz@indiana.edu)

### **FOOD SUPPLEMENTATION AND TESTOSTERONE INTERACT TO INFLUENCE REPRODUCTIVE BEHAVIOR AND IMMUNE FUNCTION IN SAGEBRUSH LIZARDS (*SCELOPORUS GRACIOSUS*)**

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The energetic resources in an organism's environment are essential for executing a wide range of life history functions, including immunity and reproduction. Most energetic budgets, however, are limited, which can lead to trade-offs among competing functions. Testosterone (T) increases reproduction and decreases immunity in many cases; increasing total energy via supplemental feedings can eliminate this effect. Testosterone and food availability are thus both important factors regulating life-history processes, yet they are often tested in isolation of each other. In this study, we considered the effect of both food availability and elevated T on immune function and reproductive behavior in sagebrush lizards, *Sceloporus graciosus*, to assess how T and energy availability affect these trade-offs. We experimentally manipulated diet (with supplemental feedings) and T (with dermal patches) in males from a natural population. We determined innate immune response by calculating the bacterial killing capability of collected plasma exposed to *E. coli ex vivo*. We measured reproductive behavior by counting the number of courtship displays produced in a 20-min sampling period. We observed an interactive effect of food availability and T-patch on immune function, with food supplementation increasing immunity in T-patch lizards. Additionally, T increased courtship displays in control food lizards. Lizards with supplemental food had higher circulating testosterone than controls. Collectively, this study shows that the energetic state of the animal plays a critical role in modulating the interactions among T, behavior and immunity in sagebrush lizards and likely other species.

41. Heather Rupp (hrupp@indiana.edu)

**MENSTRUAL CYCLE INFLUENCES ON ATTENTION TO RISK INDICATORS DURING WOMEN'S SEXUAL DECISION-MAKING: AN EYE-TRACKING STUDY**

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The decision of whether to engage in a sexual encounter requires an analysis of the costs and benefits of the potential sexual partner. We hypothesized that hormones influence the cognitive processes underlying this evaluation. To test this, 10 naturally cycling heterosexual women performed a sexual decision-making task while an eye tracker measured their gaze patterns at two phases of their menstrual cycle (follicular, luteal). Women evaluated a total of 210 photos of male faces varying in sexual risk and facial masculinity. To indicate sexual risk, faces were accompanied by written information about each man's history of condom use and number of previous sexual partners. Pictures of male faces were "masculinized" and "feminized" with Psychomorph software. For analysis, pictures were divided into two regions of interest, the face and the written information. The percentage of time spent looking at each region was compared across the two menstrual phase time points and by stimulus type. Preliminary data demonstrate that the percentage of time women looked at the face portion of the stimuli compared to the written information changed across the cycle for some types of stimuli. Specifically, women looked more at the faces, and less at written risk indicators, when evaluating low risk and masculinized men during the follicular versus luteal phase. The cyclic differences in attention reported here may help to explain previously reported cyclic fluctuations in sexual behavior and partner preferences in women, which may be, in part, due to changes in attention to cues of reward and risk.

42. David Samson (drsamson@gmail.com)

**CHIMPANZEE NESTING BEHAVIOR AT THE TORO-SEMLIKI WILDLIFE RESERVE**

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Great ape material culture has received increased attention recently from researchers interested in its relevance to human evolution. The construction of sleeping beds or "nests" is a behavioral facet that is paramount in the lives of all great apes and has been substantially overlooked. Preliminary research has been performed at the Toro-Semliki Wildlife Reserve, Uganda, during the time period of May – July 2008. The major contributions from this research can be grouped into methodological and empirical lessons. Methodological lessons include: (1) Validating tree ascending techniques which had previously been untested for feasibility of use in the field. During the six weeks of active research 192 nests were ecologically contextualized and 33 trees were climbed to gather nest dimension data. There is inherent difficulty and a substantial learning curve involved in tree clog ascending techniques in dynamic field environments, but given optimal conditions it is possible to climb 2-4 trees per day, as was done once climbing techniques were mastered; (2) For each specific tree climbed, nests quanta is readily obtainable. Dimensional variables such as length, width, depth, radii, thickness, edge thickness, circumference, nest height, and weight were gathered for a majority of the trees climbed; (3) Establish GPS coordinates for each tree and associated nest. This will prove essential for future geo-spatial analysis which will test hypotheses related to nest location preferences in relation to ecological variables.

43. Judith Scarl (jscarl@indiana.edu)

**HEIGHTENED RESPONSIVENESS TO FEMALE-INITIATED DISPLAYS IN AN AUSTRALIAN COCKATOO, THE GALAH (*EOLOPHUS ROSEICAPILLUS*)**

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Many hypotheses have been proposed to explain why in some species, males and females coordinate their behavior to defend a territory. The sex of the individual initiating a joint display may shed light on the function of the display, but this variable has not been systematically explored. This study investigates whether male-female pairs in a socially monogamous cockatoo, the galah, respond differently to male-initiated and female-initiated joint threat signals, and whether one sex is more likely to initiate a threat response. Solo male defense calls, solo female calls, male-initiated paired calls, and female-initiated paired calls were presented to pairs of galahs at nest cavities during the pre-breeding season. Birds responded most strongly to female-initiated call bouts, regardless of the number of stimulus birds giving vocalizations. While paired birds coordinated their approach responses to the stimuli, males tended to initiate these responses. These results suggest that the sex of the initiating bird, rather than the number of calling birds, is most relevant to galahs when assessing threat near an active cavity. This study indicates that it is critical to consider the separate roles of the male and female in a joint display in order to fully understand that display's function.

44. Elizabeth Schultz (elschult@uemail.iu.edu)

**NONBREEDING INTRASEXUAL AGGRESSION AND DOMINANCE IN TWO DIVERGING POPULATIONS OF DARK-EYED JUNCO (*JUNCO HYEMALIS THURBERI*)**

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Much research has focused on what traits predict social dominance and the intensity of intrasexual aggression within populations, however few studies have assessed how such relationships vary among populations in differing environments. In this study, we examined the intensity of intrasexual aggression and predictors of dominance in captive flocks of males and females that were raised in a common garden study from two recently diverged populations of dark-eyed juncos. Previous data have shown that males from the colonist population have lower levels of circulating testosterone, display less aggression, and have less tail white and head black, and more boldly explore novel environments, all of which are factors known to be related to intrasexual aggression- specifically dominance interactions. Thus, we predict that rapid evolutionary changes in dominance behavior may have occurred post-colonization. We quantified the rates of aggressive encounters within same sex 10 member flocks, and determined who won each interaction in order to establish hierarchies. Previously collected behavioral, morphological, and hormonal data will be used to evaluate which phenotypic characteristics predict dominance within each flock. Preliminary data indicate that within a flock, the UCSD males interact significantly more than the montane males and phenotypic predictors of dominance are different between the two populations. Ongoing studies include a completion of hormonal assays of breeding levels of testosterone and corticosterone from these individuals.

45. Melissa Scotti (mscotti@wisc.edu)

### **DOES ANTAGONISM OF $\beta$ 1 RECEPTORS IN THE LATERAL SEPTUM ENHANCE MATERNAL AGGRESSION?**

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Maternal aggression is a critical and, thus, highly conserved component of maternal care in mammalian systems that involves dramatic shifts in a female's response to stress and social cues. For example, female mice are typically docile throughout most of their life history; however, they become fiercely aggressive toward intruders when lactating. Previous research indicates that decreases in the norepinephrine (NE) signaling may explain differences in how females respond to stressors during lactation. Additionally, work from our lab suggests that the lateral septum (LS), which has a role in regulating aspects of mood including fear response, is a critical part of the neural pathway that controls offspring protection. The aim of the current work is to investigate the possibility that antagonism of NE  $\beta$ 1 receptors in the LS will enhance maternal aggression. To this end, on postpartum day 3 maternal females were fitted with cannulae positioned in the LS. On postpartum day 6-8 each female received a site directed injection of 1  $\mu$ g of atenolol (a specific  $\beta$ 1 antagonist), 5  $\mu$ g of atenolol, or saline. 20 minutes post-injection females underwent a 5-minute resident intruder trial in which male intruders were introduced into the females' cages. All interactions were recorded and scored for aggressive behaviors. Immediately after the aggression trials females were placed in light/dark boxes and their anxiety levels assessed. Repeated measures ANOVAs were performed to analyze behavioral data. Preliminary analysis suggests that antagonism of NE  $\beta$ 1 receptors may enhance aggression by decreasing latency to attack in lactating females.

46. Helena Soini (hsoini@indiana.edu) and Craig Hollars (chollars@indiana.edu)

### **INVESTIGATIONS OF THE SEASON, GENDER AND AGE-DETERMINED URINARY SCENT PATTERNS OF THE RED FOX (*VULPES VULPES*)**

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The red fox (*Vulpes vulpes*) is a widely spread and successful canid. It uses scents for territorial marking and other communication within the species. The main sources of scents are urine and secretions from anal and supracaudal glands. Red fox mating season is in winter. While some volatile compounds in the red fox urine were previously identified, there are no reports about seasonal variation in the red fox scents from the urine. Here, we have explored the effects of season, gender and age on the fox urinary scent profiles. We have used stir bar sorptive extraction (SBSE) in the aqueous mode, followed by thermal desorption and cooled injection (TDSA-CIS) sample introduction into capillary GC-MS. The urine samples from male and female animals in the different age groups were analyzed during and outside of the mating season. The results show that adult male urine is a very abundant scent source. Especially during the mating season, the volatile compound profiles become very rich and intense in certain sulfur-containing compounds. Several male-specific compounds were detected in urine. A large number of female specific urinary compounds were present in the adult female samples, with only few sulfur-containing compounds. Female adult fox urine was rich in terpene compounds, which increased especially during the mating season. Cub urine generally contained fewer compounds than the adult fox urine. However, some of the male-specific compounds appeared already in the male cub urine. None of the female-specific urinary compounds were found in the female cub urine.

47. Deanna Soper (dmsoper@indiana.edu)

**MATE CHOICE IN A NEW ZEALAND SNAIL**

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Mate choice is a common behavior to many species. *Potamopyrgus antipodarum* is a small freshwater snail from New Zealand whose sexual behavior, especially female mate discrimination, is unknown. Females from two populations were tested to determine presence of preference for males of sympatric or allopatric populations. This study suggests female mate discrimination for males of sympatric populations.

48. Chris Southwood (csouthwo@indiana.edu)

**CHRONIC STRESS ALTERS NEURAL ACTIVITY IN INFRALIMBIC AND PRELIMBIC CORTEX DURING RECALL OF EXTINCTION.**

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The prelimbic region of medial prefrontal cortex is critical for expression of previously conditioned fear, whereas the infralimbic region of medial prefrontal cortex plays a role in recall of extinction of conditioned fear. We have previously shown that chronic restraint stress produces retraction of apical dendrites of pyramidal neurons both regions of medial prefrontal cortex. To assess whether stress also alters neural physiology here, we compared activity in infralimbic and prelimbic cortex of unstressed and stressed rats during fear conditioning and extinction. Microwire bundles were implanted into infralimbic or prelimbic cortex. After recovery from surgery, rats were either unstressed or stressed via placement in a plastic restrainer (3 h/day for 1 week). Rats then underwent fear conditioning and extinction, receiving five habituation trials to a 30-s tone followed by seven pairings of tone and footshock. One hour later, rats received tone-alone extinction trials to criterion. The next day, rats received 15 additional extinction trials to test for recall of extinction. Stress increased freezing during acquisition of conditioned fear, did not alter initial extinction, but impaired recall of extinction. Consistent with previous reports, unstressed rats exhibited initial firing rate increases in infralimbic cortex and sustained prelimbic inhibition in response to the tone during recall of extinction. Conversely, stressed rats demonstrated initial increases in prelimbic firing, and sustained inhibition of infralimbic firing during recall of extinction. Thus, chronic stress impairs recall of extinction, and stress-induced alterations in the activity of neurons in medial prefrontal cortex may be responsible for this deficit.

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49. Cuauhcihuatl Vital (cvital@indiana.edu)

**EFFECTS OF DIFFERENT INDIVIDUALS ON INFORMATION TRANSFER IN ZEBRAFISH GROUPS.**

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Fitness of gregarious individuals is greatly influenced by several aspects of group phenotype. For instance, individual food intake is directly related to group foraging success. In this case information transfer plays an important role in group fitness. The faster information is transferred the higher chances individuals within a group have of locating food, escaping predators or acquiring other resources. Little research has been done on what factors influence information transfer in a social group. We explore the role of important individuals in information transfer. First we find important and non-important individuals- as measured by Betweenness Centrality within zebrafish groups. Second we train these individuals on a specific task to be tutors for the rest of their own groups. By removing and training important and non-important individuals we test the relevance of such individuals in transferring new foraging techniques to a zebrafish shoal. Our results suggest that socially important individuals play a more influential role in social learning. Group fitness, thus is greatly influenced by the social organization. Specifically, socially-important individuals play a key role in group fitness in activities such as group foraging.

50. Lauren Walker (lajwalke@indiana.edu)

**CORTICOSTRIATAL INFORMATION PROCESSING IS DISRUPTED AT MULTIPLE LEVELS IN THE R6/2 MOUSE MODEL OF HUNTINGTON'S DISEASE**

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Neurodegenerative diseases may be caused by dysfunction that spans multiple levels of neuronal circuit organization. We focus on Huntington's disease (HD), a progressive autosomal dominant disorder that disrupts behavioral output. Little is known about how HD alters information processing at multiple levels of neuronal circuitry. We have recorded both neuronal and network activity simultaneously within the motor cortex and striatum of behaving R6/2 mice. The R6/2 mouse model, transgenic for human HD, rapidly expresses a phenotype similar to juvenile HD. Extracellular spike activity and local field potentials (LFPs) were recorded to investigate communication in diseased corticostriatal motor pathway. We found that the deleterious effects of HD alter corticostriatal information processing at the single-unit, population, and network levels of HD mice as compared to wild-type (WT) controls. Cortical neurons in WT showed more bursting (clusters of action potentials) and had a greater number of spikes per burst than HD mice. Furthermore, WT showed more correlated firing within the cortex, striatum, and corticostriatal pathway than HD. Preliminary LFP data reveal a 30-40 Hz (gamma) oscillation during quiet rest and a 6-8 Hz oscillation during locomotion in R6/2 mice that is not present in WT. The presence of these novel oscillations appears to be diagnostic of the HD genotype. Correlational and LFP data suggest that corticostriatal miscommunication is occurring on a population and global scale, respectively, in HD mice. Our results indicate that bursting, population synchrony, and oscillations play an important role in information processing between the motor cortex and the striatum.

51. Danfeng Wang (dw3@indiana.edu)

**VISUAL PERFORMANCE IS LATERALIZED IN MALE AND FEMALE *SCELOPORUS UNDULATUS* LIZARDS**

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Behavioral laterality is the specialization of the left or right brain hemisphere in certain behaviors and functions. Many animals exhibit visual laterality and asymmetry during social interactions, foraging, and predator detection, i.e., the left and right eyes are used differentially for different tasks. For example, many animals show a left-eye bias during aggression and territorial contexts. While visual laterality has been shown to occur in many behavioral tasks and responses involving aggression, little is known whether the left and right eyes exhibit differential sensitivity, i.e., can one eye see better than the other? We measured and compared spectral sensitivity to the blue coloration exhibited by male *Sceloporus undulatus* lizards from both the left and right visual fields in adult male and female *S. undulatus* lizards. We found that left and right visual fields differ in spectral sensitivity and present here evidence for sex-specific variation of laterality. Specific results and data will be discussed.

52. Aaron Wilber (awilber@indiana.edu)

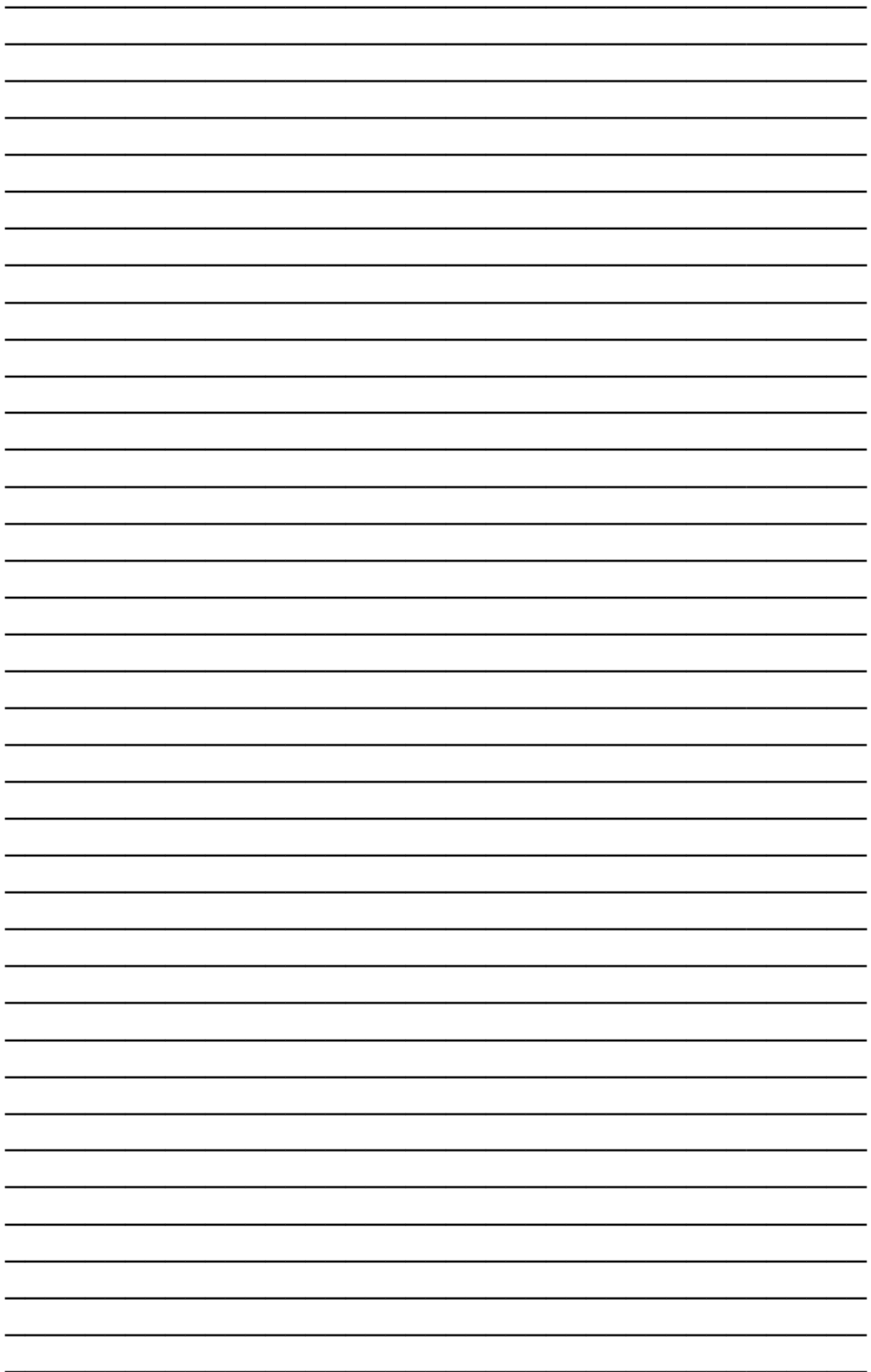
**NEONATAL MATERNAL SEPARATION ALTERS DEVELOPMENT OF GLUCOCORTICOID RECEPTOR EXPRESSION IN THE INTERPOSITUS NUCLEUS OF THE CEREBELLUM.**

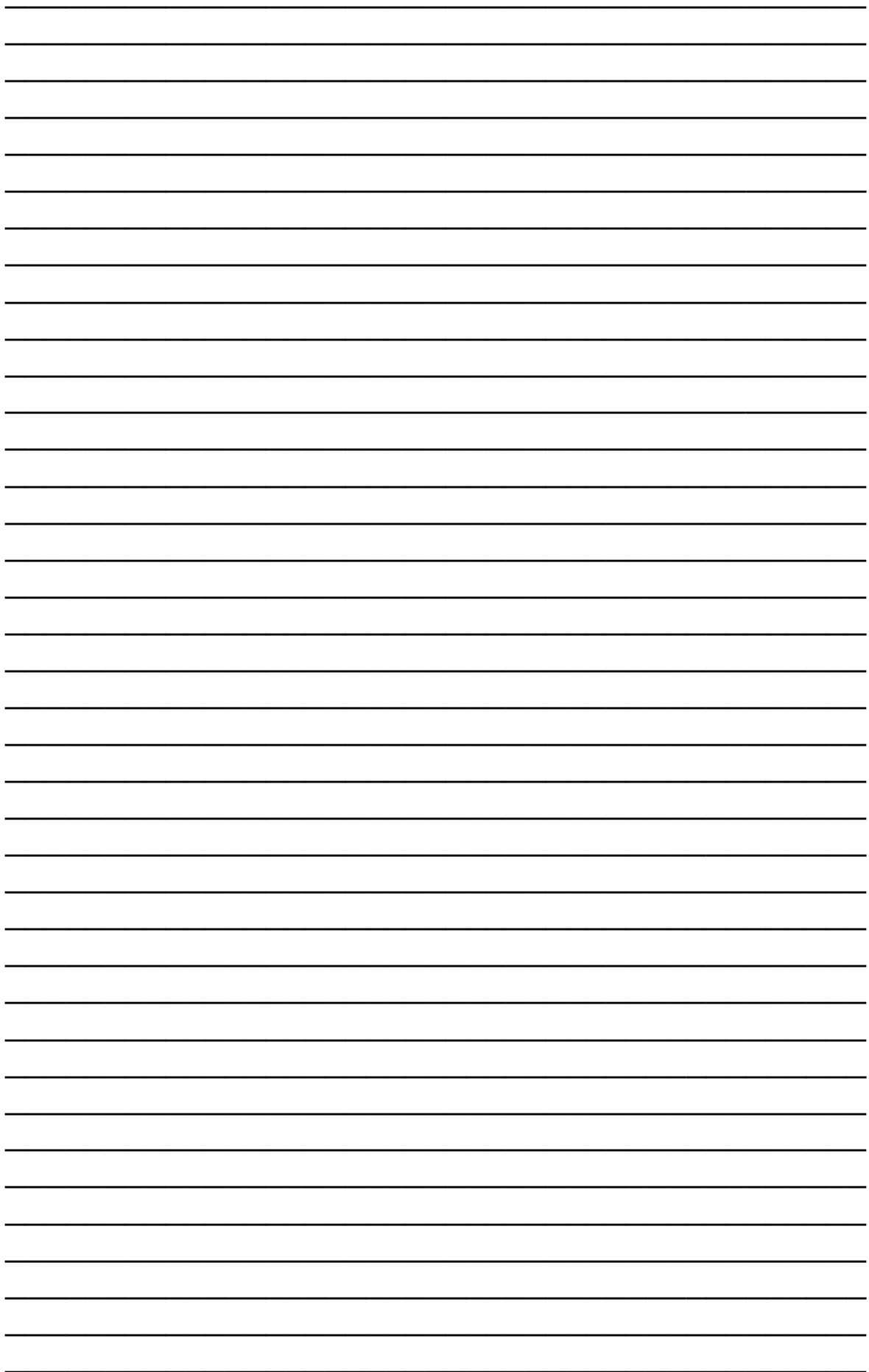
A.A. Wilber and C.L. Wellman.

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Adverse early experience impairs adult learning and memory. Previously, we showed that neonatal maternal separation impaired eyeblink conditioning in adult male rats. This impairment was correlated with increases in glucocorticoid receptor (GR) expression in the posterior interpositus nucleus, a key structure in the neural circuitry controlling eyeblink conditioning. To begin to establish how separation results in altered GR expression in adulthood, we assessed the developmental pattern of GR expression in control versus maternally separated rats. Rat pups were exposed to either standard rearing (control) or maternal separation stress (1 h/day) on postnatal days (PD) 2-14 and GR expression was assessed at PD15 and 21. As an index of neonatal stress, we weighed rats at PD15 and 21. We found that weight at both PD15 and 21 is decreased in separated rats, suggesting that the manipulation was stressful. In PD15 males there was less GR expression in separated rats than controls. In control males, interpositus nucleus GR expression declined between PD15 and 21. However, neonatal separation significantly attenuated this decline; separated rats had significantly greater GR expression in interpositus than control rats at PD21. Weight at PD15 correlated with GR expression, with increased GR expression associated with lower weight. Weight in PD21 males was not correlated with GR expression. GR expression was not altered in female rats. Thus, maternal separation could impair learning and memory in adult males by altering normal developmental changes in GR expression, and the extent of this alteration is correlated with the stressfulness of the manipulation.









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