



# ANIMAL BEHAVIOR BULLETIN

Center for the Integrative Study of Animal Behavior

WINTER 2007

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## WHAT'S INSIDE

*Faculty Research*

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2007

## ANIMAL BEHAVIOR CONFERENCE

The 2007 IU Animal Behavior Conference will be held on Monday, **April 23<sup>rd</sup>** from 8:30 am to 5:00 pm in the Frangipani Room, IMU. Breakfast will be offered at 8:30. Everyone planning to present a talk or poster must register on-line. A registration page is posted on the CISAB website: [www.indiana.edu/~animal/symposium/index.html](http://www.indiana.edu/~animal/symposium/index.html)

Plenary Speaker: **Michael J. Ryan**, University of Texas-Austin, "Brain, behavior and evolution in sexual communication in tundra frogs."

**News? Story Ideas?  
Let us know!**

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Editor: Susan U. Linville

## SPRING SPEAKERS

March 19: **Gita R. Kolluru**, Humboldt State University, "Carotenoids and immunocompetence in guppies (*Poecilia reticulata*)"

March 23: **Dominique G. Homberger**, Louisiana State University, TBA

March 23: **Anne Danielson-Francois**, Rice University, "Resolving the lek paradox: which is more important, genes or ecology?"

March 26: **Janette W. Boughman**, University of Wisconsin-Madison, "Sensory drive and the evolution of sexual isolation in sticklebacks."

March 27: **Jennifer Akst**, IU Biology, "Who claims the clams: Kleptoparasitism by adult and young herring gulls, *Larus argentatus*."

April 3: **Danielle Whittaker**, "Patterns of extra-pair fertilizations in two morphologically

and behaviorally distinct dark-eyed junco (*Junco hyemalis*) populations."

April 10: **Melissa Scotti**, IU Biology, "A role of adrenocortical steroids in the mediation of seasonal aggression in Siberian hamsters (*Phodopus sungorus*)"

April 17: **George W. Uetz**, University of Illinois, "Sex, lies and videotape: multimedia approaches to the study of multi-sensory communication in wolf spiders."

April 27: **Alison M. Bell**, University of Illinois, "Behavioral syndromes in sticklebacks."



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## **Cocaine Addiction**

Relapse is a major issue when treating cocaine addiction, with compulsive drug-seeking behavior contributing to the problem. In order to better treat the cocaine addict, it is important to understand the neurobiological mechanisms behind the addiction and develop better drug therapies.

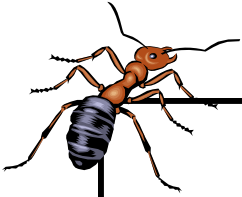
It has been suggested that the prefrontal cortex (PFC) plays a critical role in compulsive drug-seeking and drug-taking behaviors. Cocaine is thought to induce hypofunction or hypofrontality in the PFC by increasing the amount of dopamine that can attach to and stimulate various dopamine receptors. But imaging studies have not determined if the condition is induced by the drug or exists as a pre-addiction condition.

George Rebec and WenLin Sun have recently published new findings in *The Journal of Neuroscience* examining the roles of dopamine receptors in the addiction process. Seven male rats were fitted with electrodes to monitor PFC neuronal activity and trained to press a lever to self-administer cocaine in daily two hour sessions. Within the anterior cingulate and dorsal prelimbic cortex, basal firing rates (spikes/second, bursts/minute, and burst strength), and firing rates while taking cocaine were measured.

Rebec and Sun found that basal PFC activity was significantly decreased after multiple weeks of cocaine ingestion. At the same time, cocaine administration increased burst strength. This combination of low basal firing rate along with enhanced burst rate when cocaine is present in the PFC is thought to contribute to compulsive drug-seeking behavior that is so prevalent in cocaine addiction.

Rebec and Sun also have evidence that D1 and D5 dopamine receptors in the PFC are critically involved with cocaine-seeking behavior. This line of research is being pursued in the Rebec lab to assess the specific involvement of dopamine receptors in the addiction process.





## Genetic Caste Determination

For most Hymenoptera species, environment determines whether female larvae develop into workers or queens. In some populations of harvester ants (*Pogonomyrmex barbatus* and *P. rugosa*) however, genetically odd colonies do not follow the traditional rules of caste development. Dr. Michael Wade, working with Deborah Gordon and Timothy Linksvayer, proposes a solution to the riddle to this unique system of Genetic Caste Determination (GCD), in *Ecology*.

Among normal populations of harvester ants, one of the largest ant groups in the western U.S., researchers discovered populations notably different in appearance. Genetic testing further revealed a strange abnormality. Although the same DNA sequence was expected from all female ants, workers or queens, within a colony, instead, colony members belonged to one of two different lineage types, H1 and H2.

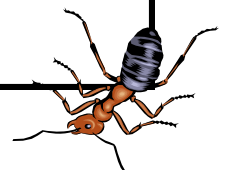
In these colonies, female caste was associated with nuclear markers. Homozygous females became reproductive queens and heterozygous females developed into workers. In order for a homozygous queen to produce both castes, she must mate with males of her own genotype as well as males with the alternate genotype.

Several models were put forward to explain the evolution and maintenance of GCD. A single-locus model suggested that caste was determined by a single genetic factor. This model explained the association of caste and nuclear heterozygosity, but not the origin of the H1 and H2 lineages. A second, two-locus, model was then proposed, suggesting that GCD was caused by incompatibilities between interacting nuclear loci. This model failed to explain how the lineages are maintained or how the hybrid GCD species was derived.

Wade and his co-authors proposed a model based on the interaction of nuclear and mitochondrial DNA that predicts both the evolution and maintenance of GCD. They demonstrated that a combination of within colony mating and out-crossing between colonies could lead to colonies expressing GCD. Females with these co-evolved cyto-nuclear genes from intra-lineage mating become reproductive, while females with disrupted gene complexes from inter-lineage mating develop into workers. Inbreeding facilitates the buildup of these gene complexes within lineages. In addition, this theory may explain the origins of workerless, social parasitic species within this group of ants, since the closest relatives of the parasitic species are often their own host species.

"Nuclear and mitochondrial genes interact to determine sex," Wade said. "The co-adaptation of nuclear and mitochondrial genes is facilitated by inbreeding, and when out-breeding occurs, it breaks up the co-adapted gene combinations."

When asked if he was going to test his model, Dr. Wade said, "We are not testing these ideas in the field yet, but we are making more detailed genetic models in order to refine our predictions." The richer the set of predictions, the more incisive will be the experiments that can distinguish among the different models.



## CISAB MEMBER ATTENDS KECK CENTER SYMPOSIUM

Since CISAB formed an alliance with the W.M. Keck Center for Behavioral Biology at North Carolina State University in 2003, students have expanded their relations through annual symposiums. This year, Sayuri Kojima participated in the 8th Annual Student and Postdoctoral Symposium to present her research entitled: “Sensations from physical contact with the mother determine odor-guided huddling in rat pups.”

In this annual symposium, pre- and post-doctoral students were encouraged to receive feedback from researchers across not only fields but also institutions including CISAB and the Center for Behavioral Neuroscience (CBN) in Atlanta, which also has a partnership with the Keck Center and CISAB. From CBN, four students participated to this symposium, Jamie LaPraire (Georgia State University), Coutney Glavis-Bloom, Jennifer Fugate, and Heather Ross, (Emory University).

The symposium included 19 talks covering a variety of topics with integrative approaches and focused on four major themes: (1) Behavior and Evolution, (2) Sex Dependence and Environmental Effects on the Expression of Behavior, (3) Courtship, Mating, and Cognition, and (4) Molecular Genetics of Behavior.

In the Molecular Genetics of Behavior session, for example, Sarah Ayroles in Genetics Department discussed how mating experiences affect behavior, physiology, and gene-expression in the honey bee queen. Honey bee queens can be categorized into “mating states” with two extremes, virgins and egg-laying, naturally-mated queens. Using instrumental insemination to create intermediate states, Ay-

roles attempted to dissociate different aspects of the post-mating response. First, she generated same-aged virgins, queens that mated once but continued to attempt mating flights (mated-not-laying), and queens that mated once and initiated egg-laying. The mated-not-laying queens were similar to virgins in their behavior (attempting to fly). However, they were intermediate in sperm number and ovary development, and similar to mated-laying queens for abdominal gene expression. Secondly, she generated more intermediate states, virgins, saline- and semen-inseminated, and naturally-mated queens to explore triggers that switch from a virgin to a mated, egg-laying queen. She found that the behavior of the naturally-mated queens again resembled the virgins, as they continued to attempt additional mating flights. However, the saline- and semen-inseminated queens did not attempt mating flights following the insemination process. Overall, her data suggested that insemination volume may play a crucial role in the transition from a virgin to a mated-egg-laying queen. She is currently collecting the physiological and molecular data, including the pheromone profiles, to correlate changes in physiology and behavior to changes in patterns of gene-expression using whole-genome.



In the session on Sex Dependence and Environmental Effects on the expression of Behavior, Jamie LaPrairie from Georgia State University and CBN noted sex difference in plasticity during the development of the CNS. Premature infants are routinely exposed to multiple invasive procedures in the absence of anesthesia during neonatal intensive care. Her research has been designed to explore how exposure to early injury during this time of increased plasticity alters the development of the CNS and influences future nociceptive response. She treated male and female rat pups with injection of an inflammatory agent into one hind paw. When the subjects were 40 and 60 days-old, sensory thresholds were measured using nociceptive behaviors (paw withdrawal and tail flick). Her results showed that neonatally injured animals showed increased pain latencies. Moreover, the pain sensitivity was significantly decreased in females compared to males, as evidenced by withdrawal latencies observed in both the injured and un-injured paws. She also examined the impact of re-injury in adulthood by hindpaw injection of another inflammatory agent at P60.



She found that neonatally injured females displayed significantly greater hyperalgesia in response to the hindpaw inflammation compared to neonatally injured males and control animals. In addition to these behavioral tests, she also conducted parallel immunocytochemical studies. The studies indicated that dorsal horn calcitonin gene-related peptide (CGRP) expression was significantly elevated in neonatally injured animals. Overall, Jamie demonstrated that even a single neonatal inflammatory insult resulted in alterations in adult sen-

sory thresholds and the developmental course of the brain characterized by increased primary afferent innervation and decreased nociceptive behavior sexually differently.

Sayuri was welcomed even before arrival in Raleigh through email communication, and she enjoyed wonderful hospitality while visiting in North Carolina. The night before the symposium, Sayuri was taken together with other student guests from CBN to a popular Italian restaurant in Raleigh for dinner to enjoy wonderful Italian cuisine and communication with host students. On the evening of the symposium, the symposium participants were invited to a dinner party at the home of a faculty member in the Keck Center, Dr. Robert Grossfeld. Fantastic Italian food and wine served at cozy atmosphere created by members in the Keck Center facilitated the attendees discussing talks presented in the symposium as well as science and careers in scientific fields in general.

Sayuri felt that this cozy atmosphere comforting and welcoming anybody may be due to cultural diversity demonstrated in the Keck Center, as represented by many international students, staff, and even the director, Dr. Robert Anholt originally from the Netherlands. The friendly atmosphere in the Keck Center reflects great efforts of the center members and encourages students to openly discuss their research and their future careers with faculty members across departments and fields. She felt that this kind of atmosphere presented by the Keck Center is important to promote integrative approach for research.

—Sayuri Kojima



# 2006 CISAB YEARLY REPORT

## ***Current Participants:***

**Faculty** = 43 faculty members representing 14 departments/programs. In 2006, we added 7 new faculty members. The number of CISAB faculty has increased by about 30% since 2003.

**Students and Affiliated Scientists** = 22 post-doc & affiliated scientists, 53 graduate and 55 UG students. In 2006, we added 4 post-docs, 6 graduate and 15 undergraduates. CISAB now has twice as many post-docs and four times the number of undergraduate members as in 2003.

## ***CISAB Core Facilities:***

The conference room in the **Main CISAB building** (402 N. Park) has been getting frequent use for courses, journal clubs, and student committee meetings. Temporary office space has been provided for several senior graduate students and post-docs, as needed.

In 2006, the **Animal Behavior lab** (136 JH) provided sample analyses for 2 major new projects, training on an additional 13 projects, and space/access to equipment to 18 people. Since its inception in 2004, 8 grant proposals and 10 manuscripts have been or will be submitted using data collected in the Animal Behavior Lab. The lab is fiscally independent in the sense that income generated from sample analysis covers the cost of expendable supplies. In 2006, the lab also ran laboratory sessions to supplement training of undergraduates in the summer program and for the A501 techniques course. We are now considering the development of a one-credit techniques course that would be available to graduate students in years that the A501 version of this course is not offered.

## ***Training Program:***

CISAB continued to provide support for the **NIH training grant** “Common Themes in Reproductive Diversity” (CTRD), which is in the second year of a 5-year award. CISAB provided office and meeting space, staff support, and funding for required graduate courses. The grant funds 4 graduate students and 2 post-docs each year.

Ten students participated in our NSF-supported **Summer Undergraduate Research Experience**. These undergraduate students from Purdue, Hunter College, U Mass Amherst, Alabama A & M, Dominican U, Wesleyan U, Albright College, Tuskegee, NC State & Loyola Marymount spent the summer conducting research in the Alberts, Brodie, Demas, Garraghty, Martins, Rebec, Smith and Timberlake labs.

Four new undergraduate and 5 new graduate animal behavior **minors and area certificates** were awarded. Three new graduates and 12 undergraduates declared their intent to pursue the minor. The number of minors has remained roughly constant for the last several years. In 2006, CISAB provided **academic advising** to more than 45 students, including 5 scheduled meetings with prospective undergraduate students and their parents.

In 2006, CISAB trained 5 undergraduate students in **Animal Behavior Internships**, including students at the Animal Shelter, WonderLab, Wildcare, and Indianapolis Zoo.

Six PhD students became **CISAB Scholars**, receiving stipend support in 2006/07. These are: Shawn Hurst (Anthro), Sayuri Kojima (Psych) Julienne Rutherford Goehl (Anthro), Melissa

Scotti (Biology) Cuauhcihuatl Vital (Biology), Devin Zysling (Biology).

Eighteen students received **CISAB Travel Awards** to present their research at major conferences. The number of travel awards has doubled in the last five years.

In 2006, CISAB graduate courses were chosen to fulfill CTRD goals. In Spring, Ellen Ketterson taught the **A502** in Professional Ethics. In Fall 2006, Ellen Ketterson also coordinated a CTRD team-taught **A501** course on “*Techniques in Reproductive Diversity*”. CISAB enrolls 25-30 students in courses each year.

### ***Seminars and other Events:***

In Spring 2006, CISAB sponsored a **Professional Skills luncheon** entitled “A PhD: Where do I go from Here?” engaging students and post-docs in a discussion about their futures.

Our annual **Animal Behavior Conference** was organized by a team of 13 graduate students. The full-day conference was attended by over 100 participants and included 19 presentations.

Our **Student Exchange** program continued with two representatives each from the **Keck Center for Behavioral Biology** (North Carolina State University) and the **Center for Behavioral Neuroscience** (Atlanta, Georgia) attending the CISAB Animal Behavior Conference and two CISAB reps attending similar symposia in North Carolina and Georgia.

The **William J. Rowland Mentoring Award** was presented to PhD student, Eduardo Fernandez (Psychological and Brain Sciences, advised by Bill Timberlake) on the application of animal learning to captive animals at the Indianapolis Zoo. This award honors students who follow the example of Bill Rowland in being exemplary mentors. Eddie Fernandez was chosen not only for having mentored a very large number of undergraduate students, but for having helped CISAB to develop the new undergraduate internship program at the Zoo.

CISAB contributed to the hosting of 9 distinguished guest speakers as part of our 2006 **Behavior Colloquium Series**: C. Hopkins (Cornell), F. DeWaal (Emory), M. Bekoff (U Colorado), A. Pai (Spelman), M.J. West-Eberhard (STRI), E. Jarvis (Duke), E. Bree-Rosenblum (Berkeley), A. Magurran (St. Andrews), T. Grandin (Colorado State). All of these were co-hosted by other campus units including EEB, Kindred Spirits Conference, Holland Lecture, IGERT mini-symposium, and the Arts & Humanities Institute.

### ***Outreach:***

CISAB participated in the **Science Olympiad** (for K-12 students), the IU **Freshman Orientation Fair**, and a presentation on “Futures in Biology” hosted by the **Biology Club**. CISAB staff also made special presentations on animal behavior training opportunities in **courses on our own campus** and to the Dept of Animal Sciences at **Purdue University**.

CISAB expanded its efforts to build a more diverse community of animal behavior researchers by coordinating the NSF-sponsored **Charles H. Turner** program which sends 10-15 undergraduates each year to the annual meeting of the Animal Behavior Society.

CISAB sent out approximately 900 **brochures** to help recruit graduate students, and joined in a Biology/Graduate School presence at **SACNAS** and **ABCRMS** meetings. Our web site continues to be extremely popular, and an important recruitment tool.

CISAB is considering hosting a joint meeting of the **International Ethological Conference (ICE)** and the **Animal Behavior Society** in 2011.

## Center for the Integrative Study of Animal Behavior

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## SUPPORT ANIMAL BEHAVIOR RESEARCH

Private contributions are an important way in which we can expand our efforts. Even a small amount can go a long way. For example, \$500 can send a student to a major scientific meeting to present their research, \$200 can buy supplies for a museum exhibit, \$25 can purchase chemicals to do DNA fingerprinting or other genetic tests, \$10 can cover the cost of distributing our Kid's Page to an elementary school class.

Charitable gifts are tax-deductible and can be mailed to: CISAB, 402 N. Park Ave, Bloomington, IN 47405  
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