Kubanek Honored with White House Award

O n May 4, Julia Kubanek, Ph.D., a CBM faculty member at the Georgia Institute of Technology, was honored at a White House ceremony with a Presidential Early Career Award for Scientists and Engineers (PECASE), one of the highest honors bestowed on scientists at the beginning of their research careers. Kubanek, who was nominated for the honor by the National Science Foundation, was among 57 scientists and engineers who received PECASE awards this year.

Kubanek, who studies harmful algal blooms called red tides, will receive up to five years of additional NSF funding for her research, which has been identified as one of the agency’s key focus areas.

A member of the CBM Affiliation Collaboratory, Kubanek is currently working with Georgia State University’s Charles Derby, Ph.D., to isolate a pheromone in the urine of female blue crabs (see pg. 2 article “Provisional Patent Awarded”).

Spring Symposium: A Learning, Memorable Experience

O n May 22, some 150 CBM faculty, students and post-doctoral fellows learned about the latest research findings on mammalian learning and behavior in the annual CBM Spring Symposium titled “Learning, Memory and Behavior.” Five leading neuroscientists—Alcino Silva, Don Plaff, Michael Merzenich, Carol Barnes and Howard Eichenbaum—delivered presentations on molecular mechanisms of learning and memory, endocrinological control of learning and behavior, structural plasticity as a mechanism of learning, and the different types of complex memory.

The symposium kicked off on May 21 with slide and poster presentations by more than 30 CBM graduate students and postdocs from CBM labs and affiliate universities.

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Researchers Make Promiscuous Voles Monogamous By Manipulating Vasopressin Receptor Gene

CBM researchers have found transferring a single gene, the vasopressin receptor, into the brain’s reward center makes a promiscuous male meadow vole monogamous. This finding, which appeared in the June 17 issue of Nature, may help better explain the neurobiology of romantic love as well as disorders of the ability to form social bonds, such as autism.

In the discovery supports previous research linking social bond formation with drug addiction, also associated with the reward center of the brain. In their study, CBM post-doctoral fellow Miranda Lim, Ph.D., and CBM Affiliation Collaboratory Head Larry Young, Ph.D., of the Department of Psychiatry and Behavioral Sciences at Emory University’s School of Medicine and the Yerkes Research Center, attempted to determine whether differences in vasopressin receptor levels between prairie and meadow voles could explain their opposite mating behaviors. Previous studies of monogamous male prairie voles, which form lifelong social or pair bonds with a single mate, determined the animals’ brains contain high levels of vasopressin receptors in one of the brain’s principal reward regions, the ventral pallidum. The comparative species of vole, the promiscuous meadow vole, which frequently mates with multiple partners, lacks vasopressin receptors in the ventral pallidum.

The scientists used a harmless virus to transfer the vasopressin receptor gene from prairie voles into the ventral pallidum of meadow voles, which increased vasopressin receptors in the meadow vole to prairie-like levels. The researchers discovered, just like prairie voles, the newly promiscuous meadow voles then displayed a strong preference for their current partners rather than new females.

Young acknowledges many genes are likely involved in regulating lifelong pair bonds between humans. “Our study, however, provides evidence, in a comparatively simple animal model, that changes in the activity of a single gene profoundly can change a fundamental social behavior of animals within a species.”

According to previous research, vasopressin receptors also may play a role in disorders of the ability to form social bonds, such as autism. “It is intriguing,” says Young, “to consider...”
When the National Science Foundation developed its Science and Technology Center program, its principle goal was to seed high-risk, innovative research and education programs that could ultimately attract new funding and become self-sustaining. Two recent developments demonstrated NSF’s hope for CBN being realized.

Georgia State University (GSU) recently launched a major new initiative in neuroscience and behavior (see pg. 7). The Brains & Behavior program, which was developed to position GSU as a national leader in the field, was realized in part because of the success of the CBN model for research and education. In addition, a group of CBN scientists associated with the Fear Collaboratory has capitalized on their discoveries about the brain’s fear mechanisms to secure a National Institutes of Health planning grant to develop a translation-al research center focusing on post-traumatic stress disorder (see pg. 9). This center, which hopefully will be fully funded within the next few years, will be the first spinoff research center to emerge from CBN.

I applaud the CBN faculty who made both programs possible. I am confident more of them will emerge as we continue to leverage our successes.

A provisional patent has been awarded to a CBN research team led by Aggression Collaboratory member Charles Derby, Ph.D., of Georgia State University (GSU) for determining the genetic sequence of an antimicrobial protein called Escapin found in the ink of the common sea slug or hare (Aplysia californica). The protein could be used in the development of new products to prevent or kill damaging microbes called biofilms that cause both the marine and health care industries billions of dollars annually.

When sea slugs encounter predators, they discharge a purple ink containing Escapin. The protein, which chemically resembles the toxins of some venomous snakes, causes foreign cells to lyse or explode and prevents bacteria from growing on sea hares. The provisional patent covers the use of Escapin to prevent biofilms that form on surfaces immersed in water, such as ships’ hulls, fishermen’s traps and nets. The patent also applies to the use of Escapin for medical purposes. Biofilms are a problem for a range of devices, including catheters, contact lenses and implants.

In their research, Derby, former postdoctoral researcher Paul Johnson, and GSU researchers Hsiu-chien Yang, Phang Tai and Cynthia Kicklighter, Ph.D.s, cloned, sequenced and expressed Escapin. With this breakthrough, Derby believes it could be possible to manufacture a natural or synthetic form of Escapin to prevent biofilms.

Over the summer, Derby plans to submit a paper for publication on the protein’s genetic sequence and its antimicrobial properties.

In a different study, Derby, Affiliation Collaboratory Member Julia Kubanek, Ph.D., of the Georgia Institute of Technology, and their post-doctoral researcher Michiya Kamio, Ph.D., are working together to isolate a pheromone in the urine of female blue crabs. The finding could lead to the development of specialized traps that lure only blue crabs and not other marine animals that can damage the traps or the crabs.

Docents Bring Genomic Revolution to the Public

As part of its ongoing education partnership with the Atlanta Fernbank Museum of Natural History, CBN has launched five under-grade fellowships and student internships from its consortium institutions to serve as docents for the “The Genomic Revolution,” the most comprehensive museum exhibit on the study of genes and their functions ever assembled.

In addition to explaining the principles behind the study of genes, the docents lead hands-on laboratory demonstrations of genomics technologies, such as polymerase chain reaction and sequencing. Over the summer, the students will be studying the impact of the exhibit and the demonstrations on enhancing the visitors’ understanding of and attitudes about genomics. “These data will allow us to better understand how we can use informal learning environments such as museums to teach the general public about important scientific issues,” said CBN Deputy Director Kelly Powell, Ph.D.

Interns for this summer’s program are Julia Sponaugle and Rashad Presley of the Georgia Institute of Technology, Amit Doshi of Emory University, and Martha Hopkins and Terry Perry of Spelman College.

Coordinating the internships are Powell and Deputy Education Director Danielle Gray, Ph.D. and Rachel Quartermore and Christine Bean of Fernbank. Robert Pyatt, Ph.D., and Tracie Rosser, Ph.D., of Emory’s Department of Human Genetics led the internship training and developed the lab demonstrations used with the exhibit.


GSU Launches $2-Million Brains & Behavior Neuroscience Program

In its bid to develop more nationally recognized research and graduate education programs, Georgia State University (GSU) has launched a new interdisciplinary initiative focusing on behavioral neuroscience.

The Brains & Behavior program, led by the Departments of Biology and Psychology and funded by a $2-million annual budget, brings together 68 faculty members from eight academic departments and five research centers to develop collaborative research and graduate education programs in neuroscience and behavior.

The program will consist of research groups who will conduct basic and applied studies in one of four areas. The Brain & Computers Group will examine interfaces that can be used in devices to help paralyzed people; Neurons & Networks will study real and artificial neural networks to develop new computational devices and to understand mechanisms of biological computation; Adaptability & Behavior will determine how life experiences such as drug abuse change brain circuits and behavior patterns; Brains & Social Behaviors will study the neural and endocrine mechanisms of social behavior in conjunction with the Center for Behavioral Neuroscience (CBN).

“The Brains & Behavior Program is designed to bring together faculty with diverse expertise to work collaboratively and train students on problems of common interest in neuroscience and behavior,” said Professor of Biology Donald Edwards, Ph.D., the program’s director. “Our hope is that this program will open new frontiers in neuroscience and behavior research and provide a unique training environment for students from many disciplines.”

Edwards credited CBN for establishing much of the groundwork that made possible the Brains & Behavior program.

“CBN has brought neuroscience programs at GSU to a higher level," said Edwards, “and Brains & Behavior will enable us to go to the next level.”

The Brains & Behavior program will eventually support 43 new graduate fellowships and 16 undergraduate internships. Ten annual seed grants up to $30,000 each will be awarded to faculty teams who pursue collaborative interdisciplinary neuroscience research. Five new junior faculty positions and two eminent scholar positions also are expected to be created for the program.

Participating departments from the College of Arts and Sciences and the Robinson College of Business at GSU include chemistry, computer information systems, computer science, mathematics and statistics, philosophy, physics and astronomy, and psychology. CBN, the Center for Brain Sciences and Health, the Center for Neural Communication and Computation and the Language Research Center also will support the program.

Provisional Patent Awarded for Sea Slug Protein Genetic Sequence

A provisional patent has been awarded to a CBN research team led by Aggression Collaboratory member Charles Derby, Ph.D., of Georgia State University (GSU) for determining the genetic sequence of an antimicrobial protein called Escapin found in the ink of the common sea slug or hare (Aplysia californica). The protein could be used in the development of new products to prevent or kill damaging microbes called biofilms that cause both the marine and health care industries billions of dollars annually.

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Gene Transfer Creates Monogamous Voles

Continued from page 1

that individual differences in vasopressin receptors in humans might play a role in how differently people form relationships.

And, Lim adds, past research in humans has shown the same neural pathways involved in the formation of romantic relationships are involved in drug addiction. “The brain process of bonding with one’s partner may be similar to becoming addicted to drugs: both activate reward circuits in the brain.”

The researchers’ next step is to determine why there is extensive variability in behaviors among individuals within a species in order to better understand the evolution of social behavior.
Radio Frequency-Based Spatial Tracking System Planned to Study Social Behavior

Continued from page 3

tracking system that can provide multiple data sources about behaviors in social groups without having to actually observe animals.

As they continue to test the visual and RF-based spatial tracking systems, Balch and Wallen said they will begin defining behavioral models that can be programmed into computer systems to automatically recognize behaviors. “For that to happen,” said Wallen, “we must answer fundamental questions about the definition of behavior. How do we infer behavior from spatial tracks, and how do we know it when we see it?”

In the long term, Balch intends to use computer models of behavior to build and program robots that work together effectively.

Balch said computer models for human behaviors could eventually be used to construct “smart homes” that understand and respond to an individual’s movements. Surveillance systems also could be developed to track shop- pers’ buying patterns in retail stores, and to flag suspicious behavior in security-sensitive environments, such as airports.

The spatial tracking system greatly improves the efficiency and accuracy of data collection, and yields an enormous amount of information that human observers otherwise could not gather, according to Wallen.

Despite its efficiency, the visual tracking system has limitations. Sometimes the system cannot distinguish between social animals and non-social animals. The system uses complex computer algorithms to create three-dimensional spatial paths from digital video recordings of a monkey’s movements while it searches for and finds treats hidden in bins throughout a large enclosure.

In a pilot study of the system at Emory University’s Yerkes National Primate Research Center Field Station, Wallen and Herman amassed more than 1,000 hours of video footage for analysis. The scientists are testing a widely held evolutionary theory that male monkeys use mental maps while females follow landmarks to remember the location of food.

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In addition to tracking the monkey’s movements, the spatial tracking system calculates the animal’s speed while moving between hidden food locations. “By knowing how quickly the monkey finds the next food treat, we can infer his confidence in remembering its location,” said Wallen. “We had no accurate way to do this before the spatial tracking system was developed.”

Balch and Wallen were recently awarded a CNB Venture Grant to develop a more sophisticated radio frequency (RF)-based system for tracking monkeys within social groups of 60 to 80 individuals. Such a spatial tracking system, they said, should provide researchers with the means to measure and study a variety of behaviors within large social groups.

Wallen and Balch hope eventually to combine the visual and RF-based systems into a single comprehensive spatial tracking system that can provide multiple data sources about behaviors in social groups without having to actually observe animals.

As they continue to test the visual and RF-based spatial tracking systems, Balch and Wallen said they will begin defining behavioral models that can be programmed into computer systems to automatically recognize behaviors. “For that to happen,” said Wallen, “we must answer fundamental questions about the definition of behavior. How do we infer behavior from spatial tracks, and how do we know it when we see it?”

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“The are a wealth of algorithms that can be applied to the problems that behavioral neuroscience poses,” said Balch. “Spatial tracking technology is a great marriage of computer science and biology.”

Wallen and Balch hope eventually to combine the visual and RF-based systems into a single comprehensive spatial tracking system that can provide multiple data sources about behaviors in social groups without having to actually observe animals.
Amygdala Growth Factor and Receptor Active During Fear Learning

The researchers measured levels of five different neurotransmitter factors in the amygdala, but identified only elevated BDNF levels. Increased levels of activat ed TrkB receptors also were discovered. Changes in BDNF and TrkB activity occurred only after the rats were conditioned to fear a light paired with a shock. Presenting the light or shock alone did not promote BDNF or TrkB activity. The researchers used pharmacologic and genetic manipulations to determine TrkB receptors are integral to the fear conditioning process. Rats who received a Trk receptor antagonist, K252a, displayed an impaired ability to learn the association between the light and foot shock. Rats who received a harmless viral vector to promote the expression of truncated TrkB receptors with impaired signalling ability also could not learn to associate the light with the shock.

Background on Rats

In the study led by Emory doctoral student and CBN Graduate Scholar Lisa Rattiner, scientists conditioned rats to fear the appearance of a light by simultaneously administering a mild electrical foot shock. The rats eventually learned to fear the light even when they were not shocked. After fear conditioning, the rats displayed significantly more aggressive and anxious behaviors when they received the estrogen/MPA combination as compared to when they received the estrogen only or the estrogen/progesterone combination. Pazol also noted a marked reduction in sexual activity during the estrogen/MPA treatment period. "Our findings suggest MPA may be affecting certain neurotransmitter systems in a very different way than natural progesterone," explained Pazol. "In comparison to natural progesterone, MPA binds to glucocorticoid receptors with a much higher affinity and may have a greater impact on the brain's stress system." Moreover, according to Pazol, unlike natural progesterone, MPA cannot be converted to the mood-regulating chemical, allopregnanolone. Changes in allopregnanolone levels have been associated with depression, anxiety disorders and premenstrual mood disorders in humans.

To identify MPA's behavioral effects over a longer period, Pazol also is examining aggression, anxiety and sexual activity in monkeys who receive the estrogen/MPA regimen for 21 days, the standard menstrual cycle for women. CBN faculty members Mark Wilson, Ph.D., chief of Yerkes' psychobiology division, and Kim Wallen, Ph.D., Dobbs Professor of Psychology and Behavioral Neuroendocrinology at Emory University and head of the Reproduction Collaboratory, also are study co-authors. Continued from page 4

National Geographic Special Stars Grober Fish

A bluebanded goby shows her goby power.

BDNF and TrkB Receptors Tied to Fear Learning

Continued on page 5

The researchers believe understanding BDNF’s role in the amygdala could also have implications for understanding Alzheimer’s Disease. Low BDNF levels have been found in the hippocampus, which controls short-term memory, in Alzheimer’s sufferers. Currently, Rattiner is using genetically engineered mice that can be manipulated to lack BDNF to isolate the brain chemical’s role in learning and memory in both the amygdala and hippocampus. The research was performed in the laboratories of Kerry Ressler, M.D./Ph.D., and Michael Davis, Ph.D. at the Yerkes Research Center and the Department of Psychiatry and Behavioral Sciences in Emory University’s School of Medicine.