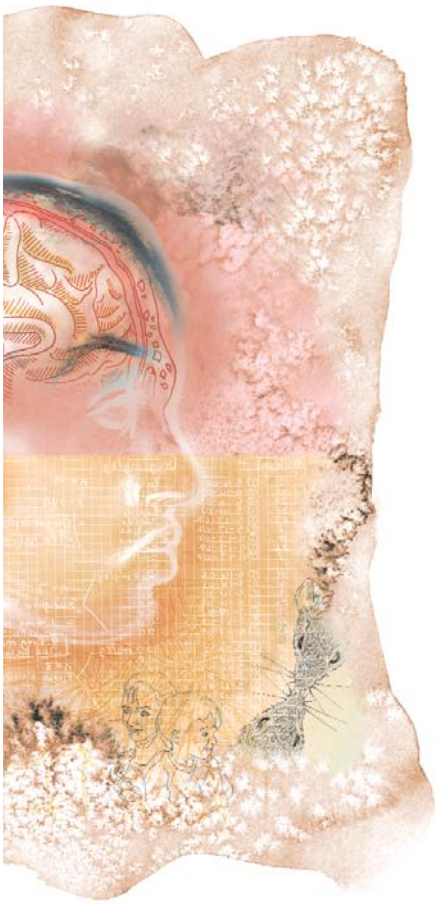

Center for Behavioral Neuroscience Annual Report

Program Year 10

Reporting from November 1, 2008
to October 31, 2009

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A NATIONAL SCIENCE FOUNDATION SCIENCE AND TECHNOLOGY CENTER • GEORGIA STATE UNIVERSITY • EMORY UNIVERSITY • SPELMAN COLLEGE • MOREHOUSE COLLEGE • MOREHOUSE SCHOOL OF MEDICINE • CLARK ATLANTA UNIVERSITY • GEORGIA INSTITUTE OF TECHNOLOGY

Center for BEHAVIORAL NEUROSCIENCE

I. GENERAL INFORMATION

1.1 Provide the following general information:

Date submitted	12/8/09
Reporting period	11/1/08 - 10/31/09
Name of Center	Center for Behavioral Neuroscience
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Center URL	http://www.cbn-atl.org
Names of participating institutions, roles and names of Pis and their contact information	
Institution 2	CLARK-ATLANTA UNIVERSITY, PI: Chuma Okere, Ph.D.
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Role of Institution	Partner
Institution 3	EMORY UNIVERSITY, PI: Stuart Zola, Ph.D.
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Role of Institution	Partner
Institution 4	GEORGIA INSTITUTE OF TECHNOLOGY, PI: Steve DeWeerth, Ph.D.
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Role of Institution	Partner
Institution 5	MOREHOUSE COLLEGE, PI: J.K. Haynes, Ph.D.
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Role of Institution	Partner
Institution 6	MOREHOUSE SCHOOL OF MEDICINE, PI: Peter MacLeish, Ph.D.
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Role of Institution	Partner
Institution 8	SPELMAN COLLEGE, PI: Michael McGinnis, Ph.D.
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Role of Institution	Partner

1.2 Provide, in one page or less, brief biographical information for each newly recruited faculty member by institution (Appendix A).

CBN recruited faculty:
YEAR 1: None
YEAR 2: Georgia State University – Matthew Grober, Deborah Baro
Emory University – Kerry Ressler, Stephan Anagnostaras
Georgia Institute of Technology – Steven Potter
Morehouse School of Medicine – Byron Ford
Morehouse College – Melissa Demetrikopoulos (science education)
Spelman College – Dolores Bradley
YEAR 3: Georgia State University – Laura Carruth (science education), Kyle Frantz (science education), Aras Petrulis
Emory University – Donna Maney, Todd Preuss, Xiaoping Hu, Stuart Zola
Spelman College – Joanne Chu
YEAR 4: Georgia State University – Anne Murphy, Tricia King
Emory University – James Rilling, Helen Mayberg
YEAR 5: Emory University – Jocelyn Bochevalier, Robert Hampton
YEAR 6: Georgia State University – Walter Wilczynski
Emory University – Robert Liu
Morehouse College – Kathy Stansbury
Spelman College – Kai McCormack
YEAR 7: Georgia State University – Erin McClure, Michael Owren
Emory University – Subhabrata Sanyal
Morehouse School of Medicine – Ketema Paul, Alec Davidson
Clark Atlanta University – Chuma Okere
YEAR 8: None
YEAR 9: Georgia State University - Bradley Cooke
Morehouse College – Daniel Hummer
YEAR 10: None

II. EXECUTIVE SUMMARY

The Executive Summary provides an overview of significant accomplishments over the 10-year tenure of the STC.

Highlights

The Center for Behavioral Neuroscience's (CBN) collaborative research team structure has changed the way the brain and behavior are studied, leading to a new, comprehensive understanding of how brain mechanisms regulate and are regulated by complex behaviors and through innovative educational programs has transmitted the excitement of behavioral neuroscience to the next generation of investigators and the public. Some of the most sweeping accomplishments of the CBN include:

1. Creating a strong, sustainable neuroscience community among Atlanta area universities and colleges that has elevated the CBN consortium to international prominence as a center for research and education in behavioral neuroscience. All CBN institutions now have vigorous and growing neuroscience research components to their academic programs and all have increased research productivity in neuroscience.

2. Pioneering a new model for "team science" in neuroscience that emphasizes multidisciplinary collaboration, multi-institutional participation, and the integration of research, education, and community outreach.

3. Supporting the careers of junior faculty, postdocs, and students at all institutions of the CBN, training the next generation of neuroscientists in the collaborative "team science" model of research and education for which the CBN is known.

4. Establishing research programs crossing institutional boundaries in several important areas of behavioral neuroscience, including but not limited to:

a. The neural basis of social bonding: Work on the role of the neuropeptides vasopressin and oxytocin from the molecular to the behavioral level have provided insights ranging from the genetic foundation of species and individual differences in social bonding to the role of these peptides in social affiliation and cooperative behavior.
b. Conditioned defeat and social status: Social stress resulting from aggressive interactions has been shown to cause persistent behavioral and hormonal differences in individuals who are the defeated targets of social aggression, as well as in individuals who dominate social contests. Neural correlates from intracellular cell signaling pathways to the role of neurotropins, to the neural receptors mediating the stress related changes are now being revealed in new research programs across CBN institutions.
c. Mechanisms of fear conditioning and extinction: Pioneering work on the behavioral and neural mechanisms of emotional learning have revealed fundamental mechanisms behind learned fear responses and the extinction, or "unlearning" of those responses. Of particular note is the discovery of the NMDA agonist d-cycloserine, which has been shown to act in the amygdala to enhance the extinction of fear responses. In addition to generating new ideas about the fundamental molecular mechanisms of emotional learning and the role of the amygdala in learned emotional responses, this work has had an impact on translational research into the treatment of post-traumatic stress disorder and phobias.

Summary

The original vision for the Center for Behavioral Neuroscience (CBN) was that it become an internationally recognized center for research elucidating the brain mechanisms of social behavior, that it educate new generations of research scientists and students in innovative, interdisciplinary ways of investigating these mechanisms, and that it transmit the excitement of behavioral neuroscience to the general public. At the end of our tenure with the NSF funding, we can report that the CBN has successfully become a national resource for the field of behavioral neuroscience, contributing new knowledge, training a diverse student population, and bringing an appreciation of science to the public at large.

The Center's accomplishments in research, education, knowledge transfer and diversity provide a rich platform from which several new interdisciplinary and inter-institutional programs in behavioral neuroscience have been launched at CBN partner institutions. The successful development and employment of collaboratories provides a unique and powerful approach to engaging investigators and students in research and education in behavioral neuroscience. The curriculum changes and program improvements at the undergraduate and/or graduate level that have occurred at all center institutions continue to encourage young scientists into the field of behavioral neuroscience. Other major strengths of the CBN are the strong partnerships that have been developed with community organizations, school systems and academic institutions outside of the CBN through which we have promoted science education at the K-12 level and in the general public.

The multi-institutional approach to the Center's scientific and educational goals have proven beneficial to all participating members. For example, the Center's multi-institutional structure has afforded many students and faculty, particularly those at the smaller member institutions, opportunities to conduct research and access to educational programs that would not be available without the Center. Research collaborations between faculty at the smaller and larger institutions would not have occurred outside of the Center's structure. Moreover, the smaller institutions have fed large numbers of students into the Center's undergraduate research program, some of whom have gone on to become graduate students in the Center's graduate program. The CBNs' graduate and postdoctoral training programs have provided a unique breadth of training in various skills by creating a network of multiple mentors and training environments. This is only a sampling of the unique opportunities that would not have exist without the Center for Behavioral Neuroscience.

A review of our research programs has indicated that the Venture Grant program has resulted in perhaps the biggest apparent professional and financial impact to participating members and their respective institutions. Over ten years, the Center has awarded approximately $2.5 million in venture grants that has seeded a reported $18 million (approximate) in new grants to continue the research begun by these small venture projects. More than 100 professional publications have resulted from these projects thusfar and we expect many more as currently active projects are completed. In addition, Center funding has supported research covered in more than 1600 professional publications and featured in more than 1850 professional presentations. Many of these papers and presentations resulted directly from the collaborative structure involving center scientists, graduate students and postdocs from multiple institutions and labs and across disciplines. The Center's technology cores have also provided critical technical support and innovation for a good amount of the research conducted by center

members from advances in imaging, microarray, viral vector, viral tract tracer, and behavioral testing technologies.

Through the Center's Graduate Scholars and Postdoctoral Fellowship programs we have supported the education of 73 graduate students and 34 postdoctoral fellows with center financial and other resources, without which many of these students and postdocs likely would not have received the broad, multi-disciplinary training experiences that the CBN offers. In addition, many of the collaborative research projects supported by the CBN would not have happened without the efforts of these graduate students and postdocs who conducted most or all of the hands-on work. Their participation has been critical for the completion of many of the venture grant projects and collaborative research throughout the Center. Center postdocs and graduate students are now spread across the nation, taking their training in how to conduct innovative collaborative research and education from the CBN into other institutions. Moreover, many of these postdocs and students continue to maintain collaborations with CBN investigators, thereby creating a virtual Center that extends across the nation.

In our efforts to increase overall student interest in studying behavioral neuroscience, the CBN has provided experiential opportunities for students at all levels and provided science curriculum enhancement at the pre-college and undergraduate levels. The Center has successfully promoted behavioral neuroscience in the K-12 science curriculum in school systems statewide by providing programs and activities that target K-12 students and teachers to educate them in behavioral neuroscience, while also providing teachers with plans to effectively disseminate their new knowledge in the classroom. Through CBN sponsored K-12 teacher-training workshops held each summer, Center scientists have helped teachers to develop neuroscience curricular materials that can be used in their own classes and by other teachers in school systems nationwide. In addition, the Center has supported hands-on science activities and exposure to research for K-12 students through programs such as the Neuroscience Exposition for the general public, summer Brain Camps for middle school students and the Institute on Neuroscience for high school students. Our summer BRAIN research program for undergraduate students has attracted students from across the nation and continues to nurture these students into graduate study in neuroscience. The evaluation of these programs shows significant impact on general interest in learning more about neuroscience and career interests of those who participated.

The Center's Knowledge Transfer efforts have focused primarily on enhancing public exposure to research and knowledge about social behavior from the field of behavioral neuroscience. In partnership with the Fernbank Museum of Natural History, we sponsored our successful "neuroscience in the movies" series including lectures and discussions of neuroscience themes as portrayed in the featured films. The Center also piloted a novel undergraduate docent training program at the Fernbank Museum in conjunction with the traveling exhibit entitled The Genomic Revolution. Our partnership with Zoo Atlanta has provided national and international media exposure for the CBN through partner projects involving the Zoo's pandas, gorillas and orangutans, increasing the visibility of the research we do in the public eye, thereby educating the public about the CBN and behavioral neuroscience research. Our partnerships with Georgia Bio, a nonprofit organization whose mission is to increase bioscience industry and its workforce in Georgia, and with the Atlanta Chapter of the Society for Neuroscience have resulted in greater visibility for the CBN within both the scientific and business communities in the state of Georgia. Along with the Center's impressive scientific

accomplishments, these "outreach" efforts have propelled the CBN into recognition as a substantial neuroscience force in the state of Georgia.

Although the CBN has enjoyed enthusiastic support from its institutional and individual members, as well as the NSF and the Georgia Research Alliance, there has been little financial support pledged toward the continuation of the Center. Although the CBN would leave behind a substantial legacy, the pieces necessary for maintaining the inter-institutional collaborations and educational efforts will be missing. Without these basic activities, it is unclear whether the very nature of the Center can be maintained. It is our assessment that even a very small amount of annual financial support would be sufficient to maintain the Center's contributions to behavioral neuroscience indefinitely. Although Georgia State University has provided money to maintain key administrative positions, more funding is still needed for research and educational programs to continue beyond the initial ten years of NSF funding.

III. RESEARCH SUMMARY

This section provides an overview of specific research accomplishments over the 10-year tenure of the STC.

The research programs of the CBN are very productive based on a number of indicators illustrated in tables and graphs below. An analysis of publications and presentations by Center members indicates that the research output of the Center has remained high. Moreover, an analysis of our publications and presentations indicates that the interdisciplinary collaborative structure of the Center continues to work very well, as the amount of collaborative research has held steady. Investigators continue to employ a variety of model systems and conceptual approaches on new projects and to employ cutting-edge technologies from advanced brain imaging to viral-vector methodology and genomic investigations into understanding the very basic mechanisms of social behavior. In addition, the technology cores of the Center have continued to contribute to the research programs of CBN, especially in the way of training individual investigators who have implemented these new technologies into their own research. Importantly, venture grant funding has been instrumental in the generation of pilot data that has then been leveraged into other support from national granting agencies as indicated in the table below. Faculty at the smaller undergraduate institutions continue to participate actively in collaboratory research, as do numerous undergraduates from all participating institutions. The authorships on Center publications and presentations also point to highly productive graduate students and postdoctoral researchers. CBN Postdoctoral Fellows and Graduate Scholars have been active members of each of the collaboratories and have been exposed to unique training opportunities and resources including, but not limited to, the core technologies. Several of the Center postdocs and students have integrated core technologies into their research projects. Some of our postdoctoral associates have been PIs on venture grants and some of these projects have been the basis of successful applications for National Research Service Awards for postdocs and graduate students.

In summary, the multidisciplinary, collaborative nature of the Center's research is providing new insights to the field of behavioral neuroscience and is opening up new areas for investigation within the Center. Moreover, this structure has proven to be greatly successful and beneficial to all involved and to the field of behavioral neuroscience as a whole.

Below are a number highlights from ten years of CBN research taken from articles printed in the Center's newsletter.

Fall 2001

Gene Transfer Spurs Pair Bonding in Monogamous Voles

Center for Behavioral Neuroscience scientists have increased bonding behavior in monogamous male prairie voles by transferring a receptor gene for the neuropeptide arginine vasopressin (AVP) into the brain. The study, which was reported in the Sept. 15 issue of the *Journal of Neuroscience*, reinforces previous findings that monogamy in voles, including the formation of pair bonds, is enhanced by the neurotransmitter vasopressin. It also is the first study to demonstrate that viral vector gene transfer can increase complex social behaviors, such as social attachment.

Larry Young, Ph.D., of the CBN and the Yerkes Research Center, and his colleagues used an adenovirus vector to deliver the gene for the vasopressin receptor (V1aR) into an area of the voles' brains called the ventral pallidum—an area already known to naturally express V1aR in monogamous voles. The gene transfer caused the voles to overexpress V1aR, thereby increasing the density of vasopressin binding to the receptor.

In their experiment, the scientists used three groups of male prairie voles that were all sexually naive. Although voles vary widely in their bonding tendencies, prairie voles are known to form strong pair bonds. The experimental group received infusions of V1aR into the ventral pallidal region; one control group received the same injection into a region of the brain that does not naturally express V1aR; and the other control group received a control vector instead of V1aR. The scientists tested each group for the presence of the vasopressin receptor and found that the experimental group had nearly a 100 percent increase in receptor density in the ventral pallidal area compared with the control groups.

Because vasopressin has been shown to increase anxiety in rats, the scientists also tested the voles in a maze that measures general anxiety and found that the experimental group exhibited more general anxiety than the control groups. When they placed the voles in cages with other juvenile males for ten minutes, the experimental group spent much more time huddling and investigating the other animals than did the control groups.

In a partner preference test, the male voles were first allowed to interact for 17 hours with a nonestrous adult female, but the voles did not mate. Following the cohabitation, the experimental males were placed in individual chambers between their partner and another unknown female. During a three-hour test, 12 out of 13 of the experimental voles spent more than twice as much time in the partner's cage than in the stranger's cage, whereas there was no particular preference for the partner in the control animals. In past experiments, male prairie voles have not developed a partner preference in less then 24 hours of cohabitation unless mating occurs.

The CBN study is the first to identify the ventral pallidum region of the brain as a key to social behavior and attachment. In addition, it shows that animals expressing higher levels of the vasopressin receptor in the ventral pallidum display higher levels of affiliative behavior and are more likely to form a pair bond than animals with a lower level of receptor in that brain region.

Scientists previously have demonstrated that monogamy in voles, including the formation of pair bonds, is enhanced by vasopressin and that an antagonist for the vasopressin receptor can prevent the formation of pair bonding. Scientists also know that all monogamous vole species, even though they may be unrelated, have denser vasopressin receptor binding in the ventral pallidal region of the brain than do non-monogamous vole species.

The CBN scientists believe their research may be ultimately helpful in developing future studies in humans of psychiatric diseases.

In addition to Young, the research team included Lauren J. Pitkow, Ph.D., Catherine A. Sharer, Ph.D., and Thomas R. Insel, M.D., of the Center for Behavioral Neuroscience and Xianglin Ren, Ph.D., and Ernest F. Terwilliger, Ph.D., of the Harvard Institutes of Medicine.

Winter 2002

Memory of Social Interactions Regulated in Medial Amygdala

Scientists from the Center for Behavioral Neuroscience (CBN) have identified the neuronal pathways involved in the formation of memories of social interactions between mice. The finding, which was reported in the Oct. 15, 2001, issue of *The Journal of Neuroscience*, could lead to a better understanding of disorders characterized by social dysfunction, such as autism.

Led by the Affiliation Collaboratory's Larry J. Young, Ph.D., and graduate student Jennifer Ferguson, the CBN research team studied mice genetically engineered to lack the neurotransmitter oxytocin.

As expected, both the normal and oxytocin-deficient mice spent more than one minute sniffing a new acquaintance—the mouse equivalent of an introductory handshake. In an earlier study (Nature Genetics, 2000), a CBN team led by Jim Winslow, Ph.D., demonstrated that oxytocin-deficient mice lack social memory. While a normal mouse spent only a few seconds sniffing its former acquaintance, a mouse lacking the oxytocin gene sniffed the initial mouse for more than a minute, as if it were their first encounter.

In the new study, the CBN team compared the patterns of neuronal activation after the initial social encounter between the normal mouse and the oxytocin-deficient mouse. They determined that neuronal activation in the normal mouse followed the predicted pathways through the olfactory system that regulates the sense of smell and through the medial amygdala, an area of the forebrain that has a high density of oxytocin receptors. In the genetically engineered mouse, by contrast, the social encounter activated only neurons in its primary olfactory structures.

Injecting oxytocin into the medial amygdala of genetically engineered mice, the researchers found that the mice regained their capacity for social memory. In a similar experiment, the scientists also determined that normal mice failed to remember a social encounter after they were administered a special compound to block oxytocin receptors in the medial amygdala.

According to Ferguson, this latest study demonstrates how and where the brain processes information of a social nature.

"This is the next step in understanding how the brain processes social information," said Ferguson, "and could lead to a better understanding of the root of social disorders such as autism."

Ferguson said that inadequate levels of oxytocin in the amygdala could explain the inability of autistic people to properly process social stimuli, leading to their profound social deficits.

In addition to Young and Ferguson, the research team included J. Matthew Aldag, B.S., and Thomas Insel, M.D.

The study was funded by the National Alliance for Autism Research and the National Science Foundation.

Spring 2002

Fear's Antidote? Discovery in rats may yield new treatment for phobias

Football commentator John Madden fears flying. Acclaimed singer Barbara Streisand fears pubic appearances. Ironically, even the head of the CBN's Fear Collaboratory was once afraid of speaking in public.

"I eventually overcame my fear, but a lot of people never do," said Michael Davis, Ph.D., of the Department of Psychiatry and Behavioral Sciences at the Emory University School of Medicine. "For some, excessive fear can be paralyzing and debilitating."

As a behavioral neuroscientist, Davis has spent almost two decades puzzling out the brain systems and neurocircuitry involved in fear. With this knowledge, one of his goals has been to develop a therapeutic adjunct to psychotherapy for people suffering from a range of disorders associated with the fear response.

Davis and his colleagues recently discovered what could be a significant breakthrough in this effort. Administering a drug called D-cycloserine (DCS), which has been used for years to treat tuberculosis, Davis successfully suppressed the fear response in rats that had been conditioned to associate the appearance of lights with an electric shock. DCS did not promote fear extinction in the absence of lights. Instead, Davis found it had to be administered at the same time the lights—the fear stimulus—appeared.

Rats provide ideal models for understanding the fear response. Using classic fear conditioning, Davis teaches the rats to associate the appearance of a light with an electric shock. He can confirm that the animals are afraid because they are more easily startled by a loud sound when the light is on. By the same conditioning, he can extinguish their fear response after repeated episodes when the appearance of the lights does not result in an electric shock.

In the early 1990s, Davis demonstrated that the NMDA receptor in the amygdala regulated the fear response. NMDA antagonists blocked both the ability to learn a fear and, in animals that had learned to associate the lights with the shock, prevented fear extinction. Despite the absence of shock, Davis found that rats treated with the NMDA antagonist continued to jump in anticipation of the shock.

DCS is an NMDA agonist that enhances synaptic transmission between the amygdala and other parts of the brain.

"Memories of aversive events probably never go away," said Davis. "Instead, most people learn to deal with fear memories or suppress them. DCS, when administered simultaneously with the presentation of the fear stimulus, basically promotes a new form of learning to cope with memories of an aversive event."

Given that it is already FDA approved, Davis and a research team that includes Fear Collaboratory members Kerry Ressler, M.D./Ph.D., and Barbara Rothbaum, Ph.D., are planning a clinical trial to assess the drug's ability to promote fear extinction in people suffering from a variety of phobias, anxiety, panic, and post-traumatic stress disorders. The study will draw on Ressler's and Rothbaum's clinical experience in treating post-traumatic stress disorders and Rothbaum's ability to create virtual reality simulations of fear-inducing events.

For someone who had an excessive fear of heights, Rothbaum has simulated a self-controlled glass elevator going up the outside of a 50-story building. Acrophobics initially can rise only to the second or third floor. But after several sessions, they can go to higher floors.

"DCS should speed up this process," said Davis. "Virtual reality technology provides a well-controlled psychotherapeutic situation to confirm if DCS will improve the outcome of treating acrophobics and, hopefully, people suffering from more complex anxiety conditions, such as panic and post-traumatic stress disorders."

While cautious about whether DCS can permanently extinguish a debilitating fear disorder, Davis sees much opportunity to explore the drug's ability to treat a variety of psychological disorders, even drug addiction.

Davis' DCS study appeared in the March 15 edition of *The Journal of Neuroscience*. His co-authors include David Walker, Ph.D., Ressler, and Kwok-Tung Lu, Ph.D., of the Department of Psychiatry and Behavioral Sciences in the Emory School of Medicine.

Winter 2003

Visual Sexual Stimuli Produce Higher Levels of Amygdala Activation in Males Than Females

A CBN study, led by Stephan Hamann, Ph.D., and Kim Wallen, Ph.D., of the Department of Psychology at Emory University, has found visual sexual stimuli produce much higher levels of activation in the amygdala of the male brain than the female brain. The finding demonstrates men and women process visual sexual stimuli differently and it may explain sex variations in reproductive behavior.

In the study, Hamann, Wallen and psychology graduate student Rebecca Herman showed 14 male and 14 female participants several types of sexual and social interaction images for a total of 30 minutes and then compared their brain activity using functional magnetic resonance imaging (fMRI), a technology that measures neural firing through changes in blood flow.

The fMRI scans revealed significantly higher levels of activation in the amygdala, which controls emotion and motivation, in the brains of the male subjects compared to the females, despite the fact that both males and females expressed similar subjective assessments of their levels of arousal after viewing the images.

"If males and females found the pictures equally arousing, you would assume they would have similar patterns of brain activation," said Hamann. "But we discovered the male brain seems to process visual sexual cues differently."

Hamann and Wallen had a separate group pre-select the images to ensure they would be equally arousing to both males and females. The sex difference accounted for the only variable between the subjects.

A growing body of research in animals and humans indicates the amygdala plays a central role in male sexual behavior. In studies of male rats who had their amygdalas removed, researchers found the animals do not respond to typical sexual cues, such as odors. Removing the amygdala from the brains of female rats, however, does not appear to affect their sexual behavior.

The scientists' discovery, which was reported at the Society for Neuroscience conference in November 2002, also is consistent with an evolutionary theory that natural selection spurred the development of different sexual behaviors in males and females.

"There is an advantage for males in quickly recognizing and responding to receptive females through visual cues," explained Hamann. "This allows them to maximize their mating opportunities, which increases their chances for passing on their genes."

For their next project, Hamann and Wallen, who are members of the Reproduction Collaboratory, plan to examine the effect of testosterone on brain activity in males and females when exposed to visually arousing sexual stimuli.

A CBN Venture Grant funded their latest research project.

Spring 2003

A New View of the Crayfish Brain

A CBN research team led by Emory University's Xiaoping Hu, Ph.D., and Georgia State University's Don Edwards, Ph.D., has developed a magnetic resonance imaging (MRI) technique using manganese for identifying anatomical structures and neural pathways in the crayfish brain.

The technique, which was adapted from an imaging technique used on rodents, employs the paramagnetic element manganese to image neural activity in living crayfish whose brains measure only 3 mm. wide. Initial tests of the technique have yielded detailed anatomical images of the crayfish brain that have never before been seen.

"Prior to the development of this technology, it would take weeks of histology to identify simple structures in the crayfish brain," said CBN post-doc Jens Herberholz, Ph.D. "Now we can generate these images in just a few hours."

Neuroscientists have been studying crayfish, an invertebrate, for more than 50 years. Their simple neural network and well-defined social hierarchies make the animals ideal models for behavioral research, especially studies of aggression.

In an initial encounter, two crayfish typically will fight one another until dominant/subordinate roles are established. These roles remain stable between the two animals, but may change when they encounter other crayfish.

A signature behavior associated with crayfish aggression is the tail flip. One type of tail flip indicates aggressiveness, while others signify subordination and the intention to escape.

In their research, Edwards and Herberholz have been using conventional methods of electrophysiology to determine the neural circuitry of the tail flip. The technique, however, can only delineate single neural pathways. With manganese-enhanced MRI, the scientists hope to determine activation of multiple pathways simultaneously.

"Our goal is to use manganese as an activity marker for identifying entire patterns of brain activation in dominant and subordinate crayfish," said Herberholz. "We also want to compare changes that occur before and after an aggressive encounter."

MRI technology, which was developed for imaging the human brain, has rarely been used to study a brain of the crayfish's small size. To overcome the limitations of the technology, Hu, head of the Imaging Core, and Herberholz are working to improve the resolution of their small animal MRI scanner and develop a more sensitive coil customized to the crayfish's head.

Manganese can be rapidly infused into the crayfish brain and is well tolerated. For these reasons, Hu projected it will be possible to conduct longitudinal studies of individual animals using MRI technology to assess changes that occur in the animals' brains over an extended period.

Hu and Edwards said the development of manganese-enhanced MRI for studying the crayfish could not have happened without the CBN. Hu recalled an initial meeting last year when Edwards spoke of his need to image the crayfish brain. "I had never before worked with crayfish," said Hu. "Now we have a powerful new tool for studying the invertebrate brain."

Spring 2003

Early-Life Environments Shape Stress Behaviors and Learning Ability

CBN researchers have demonstrated that genetically identical mice placed in different environments both pre- and post-natally differ dramatically as adults in their stress responses and learning abilities. The finding, reported in the May issue of *Nature Neuroscience*, suggests that pre- and post-natal maternal environments, when taken together, play a strong role in determining the stress profile and cognitive development of genetically identical mice.

In the study led by CBN post-doc Darlene Francis, Ph.D., of Emory, and former CBN director Thomas Insel, M.D., the scientists selected two in-bred mouse strains known to differ in their stress reactivity (high versus low) and cognitive performance.

To gauge the influence of different uterine and early-life environments on development, the scientists transferred embryos from recently mated low-stress (B6) female mice to female surrogates from the strain that displayed high-stress reactive profiles (BALBs). For comparison purposes, they also transferred embryos to surrogate females within the same strain.

At birth, all mice were cross-fostered again and reared by either a low-stress B6 mother or a high-stress BALB mother. When all of the offspring reached adulthood at three months of age, the researchers compared their stress reactions and cognitive performance. The low-stress B6 mice that were transferred as embryos to and also later reared by surrogate BALB females demonstrated an increase in stress-reactive behaviors. These mice were less likely to explore new environments than their counterparts that were carried and reared by low-stress mothers. The low-stress B6 mice reared by surrogate BALB females also performed more poorly on cognitive tests of their ability to navigate mazes.

"We completely reshaped the presumed genetic differences between the in-bred mouse strains by changing the pre- and post-natal environmental conditions," said Francis. "The maternal care received by the mice, in addition to the uterine environment, produced a cascading effect on the animals' stress profile and cognitive performance."

Summer 2004

Researchers Make Promiscuous Voles Monogamous By Manipulating Vasopressin Receptor Gene

CBN 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 addition, the discovery supports previous research linking social bond formation with drug addiction, also associated with the reward center of the brain.

In their study, CBN post-doctoral fellow Miranda Lim, Ph.D., and CBN 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 formerly 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 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.

Summer 2004

Translational Research Center to Develop New Treatments for PTSD

In the first major outgrowth of CBN-sponsored research, an interdisciplinary group of eight scientists at Emory, Georgia State University and the Atlanta Veterans Administration Hospital is organizing a translational research center to develop new treatments for post-traumatic stress disorder (PTSD). The center's development is funded by a three-year, $1-million grant from the National Institutes of Heath.

The brain's fear systems govern responses to psychologically traumatic experiences such as combat, rape, childhood neglect and physical abuse. In a normal brain, a process called fear extinction allows a person to overcome the initial intense anxiety created by these experiences. For reasons not understood, the systems that inhibit fear and return the brain to a normal state do not work properly in PTSD sufferers. Currently, there are no long-term effective treatments for PTSD, a condition that affects an estimated eight percent of the population.

Researchers within the developing translational research center, using animal models and humans, will study the brain's fear mechanisms and attempt to determine how they malfunction in PTSD sufferers.

Of particular interest will be the role of safety signals. A hallmark of PTSD and many anxiety disorders is the brain's inability to distinguish between safe and threatening situations. For instance, the brain of a combat-fatigued soldier returning home with PTSD may respond to a car engine backfire in the same fearful way as a gunshot. Center researchers will use brain imaging techniques to compare activity in healthy human volunteers and PTSD sufferers after exposure to safety signals.

In other studies, scientists will condition subjects to fear different stimuli and then assess methods for promoting extinction at various intervals after exposure to the stimuli. Eventually, they plan to assess a number of pharmacological and psychotherapeutic interventions to facilitate fear extinction in PTSD sufferers.

After the initial three-year development grant, the researchers hope the center's pilot studies will generate an NIH Center grant to support a PTSD research center for the long term.

Fear Collaboratory Head Mike Davis, Ph.D., of the Emory University School of Medicine, who will help develop the center, said much of its groundwork has been laid over the last several

years as a result of CBN research on fear conditioning and extinction, safety signals and social defeat, among other studies.

In addition to Davis, members of the developing translational research center include Emory School of Medicine researchers Barbara Rothbaum, Ph.D., Douglas Bremner, M.D., Charles Nemeroff, M.D./Ph.D. and Kerry Ressler, M.D./Ph.D., Emory Psychology Professor Stephan Hamann, Ph.D., Georgia State University Biologist Kim Huhman, Ph.D., and Erica Duncan, M.D., of the Atlanta VA.

Summer 2005

New Clinical Tool to Help War Veterans with PTSD: Determines extent of impairment in brain's fear-control mechanisms

A new clinical tool for assessing post-traumatic stress disorder (PTSD), developed by CBN, the Atlanta Veterans Affairs Medical Center (VAMC), and Emory University School of Medicine, could enable researchers to develop better treatments for war veterans and others suffering from the disabling anxiety disorder. Pilot studies of the system are currently being conducted with Vietnam War veterans at the Atlanta VA, and will soon be launched with Iraq War veterans at Fort Bragg, NC, and Serbo-Croatian War veterans in Zagreb, Croatia.

PTSD, which affects an estimated 20 percent of veterans in recent conflicts, is a dysfunction of the brain's fear control mechanisms resulting from a psychologically traumatic experience, such as combat. One of the central features of the disorder is the inability of the brain to distinguish between safe and dangerous situations.

"The sound of a helicopter flying overhead can be enough to trigger anxiety or panic attacks in vets with PTSD," said Tanja Jovanovic, PhD, an Emory and CBN post-doctoral fellow in the laboratory of Erica Duncan, MD, of the Atlanta VAMC, CBN and the Department of Psychiatry and Behavioral Sciences at Emory University School of Medicine. "They know that they are not back in combat, but they can't suppress their fear."

The new PTSD testing system determines the extent of the impairment in the brain's fear-control mechanisms. A patient is initially conditioned to fear a series of lights by pairing their appearance with an aversive air blast to the throat. A second set of safety lights are then presented without an air blast. Finally, the two sets of lights are displayed together without an air blast to test the patient's ability to inhibit their fear of the lights. Electrodes attached under the eye measure fear responses based on blink size during each of the three tests. Larger blinks indicate a greater fear reaction.

In a preliminary study of Vietnam War veterans, Jovanovic and her colleagues determined PTSD sufferers were more afraid of the lights than control subjects. Veterans with more severe PTSD symptoms also could not inhibit their fear when presented with both sets of lights, indicative of the dysfunction in their fear control mechanisms.

Clinicians typically assess PTSD sufferers based on subjective accounts of their symptoms. "This new system will provide a new way to objectively test their fear control mechanisms," said Jovanovic. "Our hope is that it will lead to the development of more effective treatments for PTSD other anxiety-related disorders."

The researchers' next step is to determine whether specific genes are involved in fear inhibition. Other studies are using functional magnetic resonance imaging to examine brain activation patterns involved in fear inhibition.

Development of the human PTSD testing system was based on animal research conducted by Karyn Myers, PhD, and Michael Davis, PhD, of Emory University and CBN. Additional

researchers at the Atlanta VAMC and Emory involved in the human studies include Seth Norrholm, PhD, Megan Keyes, PhD, and Ana Fiallos, BSEE.

Winter 2006

Growth Factor Protects Brain from Stroke Damage: Finding Could Lead to the Development of New Stroke Treatments

A naturally occurring growth factor called neuregulin-1 protects brain cells from damage resulting from stroke, according to an animal study conducted by CBN researchers at Morehouse School of Medicine (MSM). The finding, reported in the current online edition of the *Journal of Cerebral Blood Flow and Metabolism*, could lead to the development of new stroke treatments.

Stroke, the third leading cause of death in adults in the United States, occurs when blood flow to the brain is interrupted. Deprived of oxygen, brain cells die within minutes, causing inflammation and further damage to tissue surrounding the site where blood flow is obstructed.

In the study, a research team led by CBN molecular core head Byron Ford, PhD, of the MSM Neuroscience Institute and Department of Anatomy and Neurobiology, examined the effects of administering neuregulin-1, a protective compound which neurons produce naturally, to rats after surgically induced strokes. The scientists discovered neuregulin-1 reduced cell death by 90 percent compared to rats that did not receive it. The compound also protected neurons from damage even when administered as long as 13 hours after the stroke's onset.

In DNA microarray analysis of the affected brain tissue, Ford and his team determined neuregulin-1 produces its protective effects by turning on or off nearly 1,000 genes that regulate cell death and inflammation. Neuregulin-1 also blocks the production of free radicals, compounds that have been implicated in cell injury and aging.

Currently, a drug called TPA is the only available stroke treatment, and must be administered within three hours of stroke onset to be effective.

"The biggest potential benefit of neuregulin-1 is that its therapeutic window is much longer than TPA, potentially up to 48 hours," said Ford. "It also appears to easily cross the blood-brain barrier and does not produce any obvious side effects in rats."

Ford has filed two provisional patents for the uses of neuregulin-1 as a stroke treatment and promoting the growth of endogenous neural stem cells to replace damaged neurons. He also was recently awarded a five-year R01 grant from the National Institute of Neurological Disorders to begin pre-clinical studies of neuregulin-1 as a stroke therapy. As part of this project, Ford will test neuregulin-1 in additional animal models and conduct imaging studies to determine the optimal therapeutic window for the compound to be protective. He also intends to better characterize the molecular processes involved in the stroke process to facilitate the development of novel stroke therapies.

In collaboration with CBN colleague Kerry Ressler, MD/PhD, an Emory University researcher, Ford also is studying the function of neuregulin-1 in the brain's fear mechanisms and its possible connection with schizophrenia. Schizophrenia, which is characterized by a dysfunction of the brain's fear mechanisms, has been linked to a mutation in the neuregulin-1 gene. Other studies have found that schizophrenics have lower than normal brain levels of neuregulin-1.

Co-authors of Ford's latest stroke study include graduate student DaJoie Croslan, postdoctoral fellow Adalynn Harris, PhD, and research assistant Gregory Ford, all of the MSM Department of Anatomy and Neurobiology, and Zhenfeng Xu, MD/PhD, a postdoctoral fellow at Johns Hopkins University.

Summer 2006

Stress Prompts Hamsters to Overeat: These Rodents May Hold the Answer to Battling Human Obesity

Pressures at work, conflicts in personal relationships, childcare demands and traffic snarls – many people deal with such day-to-day stress by overeating resulting in weight gain and obesity. Is there relief in sight?

CBN (Center for Behavioral Neuroscience in Atlanta, Ga.) researchers say Syrian hamsters may hold vital clues to curbing those unhealthy cravings.

Until now, rodents have not been useful as a model for human stress-induced obesity because the typical response of laboratory rats and mice to a wide range of stressors is to decrease food intake and body weight, but a CBN collaboration has found this isn't the case with Syrian hamsters.

In the study published in the May issue of the *American Journal of Physiology. Regulatory, Integrative and Comparative Physiology*,* GSU scientists Tim Bartness and Kim Huhman along with CBN graduate students, Michelle Foster and Matia Solomon, confirmed that not only do Syrian hamsters increase body and fat mass under social stress, but interestingly enough, most of the weight is gained in the abdominal area (visceral fat), making this species an ideal model for human stress-induced obesity.

The group conducted a series of resident-intruder sessions where they placed an 11-week-old hamster (subordinate intruder) in a cage with an older hamster (dominant resident). After several seven-minute trial periods, a clear dominance hierarchy developed between the hamsters where one of the animals showed subordinance or "defeat" in the presence of the other.

The results of the study showed that social stress produced by subjecting Syrian hamsters to defeat reliably triggered increased food intake and body and lipid mass. Therefore, this form of social defeat, a natural stressor, mimics many of the effects of nontraumatic stress in humans by resulting in increased food intake and adiposity, including enhancement of visceral fat growth. A second paper recently accepted at AJP, indicates that in dominant-subordinate pairings, only the losers (defeated hamsters) and not the winners (dominant hamsters) show these changes.

Bartness and Huhman hope that this model can be exploited in the future to uncover the brain mechanisms underlying this whole process. With such knowledge, it might be possible to generate pharmacological approaches to attack stress-induced obesity in humans and block or reverse it.

Bartness credits the success of this research to graduate student interactions fostered by the CBN.

"What really got this research going was the friendship between Matia Solomon in Dr. Huhman's lab and Michelle Foster in my lab. They are the energy behind getting this research off the ground and did all the work. It would have never happened if it wasn't for the CBN, that is for sure."

Fall 2006

CBN Aids in birth of Giant Panda Cub

On the afternoon of Sept. 6, 2006, three years of hard work paid off when Zoo Atlanta announced its giant panda, Lun Lun, had given birth to her first cub.

As the news spread, people around the world joined in the celebration, including a few investigators in the Center for Behavioral Neuroscience who began working with the zoo

in late 2003 to aid the artificial insemination process in the giant panda.

"I am so happy Lun Lun had a baby," said Georgia State University's Mary Karom, laboratory supervisor for CBN Director Elliott Albers. "She certainly gave us a run for our money."

CBN joined the effort to artificially inseminate Lun Lun after attempts to naturally mate the female panda and her male mate, Yang Yang, were unsuccessful. Albers offered his lab's assay services to improve the efficiency of the estrogen testing process.

In the fall of 2003, Karom met with Zoo Atlanta Curator of Giant Panda Research and Management, Dr. Rebecca Snyder, and soon began working to validate a commercial kit that would determine Lun Lun's peak ovulation period in just a matter of hours as opposed to days.

Previously, the San Diego Zoo measured Lun Lun's daily estrogen levels, but due to the distance from Atlanta, the results would often not be available for a few days. Because pandas only go into estrus once a year, in March, and the peak mating period is a short window of only three or four days, it is critical to predict receptivity of the female for mating right away. Karom's assay and the close proximity of the CBN to the zoo made quick assay results a reality.

"I could run the assay using our kit and get results to Dr. Snyder in about four hours as opposed to days," Karom said. "With results this fast, they (the zoo staff) could compare behavioral and hormonal changes in Lun Lun on the same day to determine optimal artificial insemination, and with only a three-day window for conception, this information was very helpful."

Snyder also composed graphs charting the daily hormone assay results. These graphs, developed in partnership with the CBN, were displayed to the public outside the panda exhibit as part of an information panel about giant panda reproduction.

"The panel explains that hormonal information provided by the CBN is important for predicting ovulation and the birth window for Zoo Atlanta's female giant panda, Lun Lun," Snyder said. "The panel also allows us to display a chart of the female's hormone profile, so visitors can track her progress during estrus and possible pregnancy. This chart is updated daily during estrus and weekly during possible pregnancy. It's very popular with zoo visitors and helps people to understand the science behind giant panda reproduction."

Spring 2008

Research May Enhance Social Cognition for People with Autism

The Centers for Disease Control estimates that 1-in-150 children nationwide are diagnosed with autism spectrum disorder (ASD), making it more common than pediatric cancer, diabetes, and AIDS combined. These statistics have led some to refer to the behavioral disorder as an "urgent public health concern."

ASD is a developmental disorder characterized by aberrant social interactions, impairments in communication and repetitive stereotyped patterns of behavior. CBN student Meera Modi is conducting research that may lead to a potential treatment that could enhance social cognition and ameliorate some of the social deficits in ASD.

Modi is a rising fourth-year Emory University Neuroscience Graduate program student who works in the lab of Larry Young, Ph.D., Professor in the Department of Psychiatry and Behavioral Sciences at Emory University's School of Medicine and the Yerkes National Primate Research Center

Previous CBN-supported research in Dr. Young's lab found that mice lacking oxytocin fail to process social cues normally and that oxytocin receptors in the brains of monogamous prairie

voles promote social bonding. Based on these results, it has been suggested that inadequate levels of oxytocin, possibly in the amygdala might explain the inability of autistic people to recognize social cues and to create normal social relationships.

"I am working to develop social bonding in the prairie vole as a predictive model for the development of drugs that may be useful in enhancing social cognition in individuals with autism," Modi said. "Prairie voles have a much more complex repertoire of social behavior than either rats or mice, and social bonding in voles relies on a series of social cognitive processes. By studying an animal with complex social behavior we are better able to characterize specific phenotypes, look at the neurobiological mechanisms underlying them and determine how different pharmacological agents may affect them."

As a part of an Autism SpeaksFellowship she received in December 2007, Modi will conduct a series of experiments designed to understand the interaction between oxytocin and glutamate, which includes testing whether clinically available glutamatergic compounds can enhance social cognition in the prairie vole.

"Both oxytocin and drugs that target the glutamate system are currently under investigation as possible therapeutic agents in autism so our studies are important to clarify how they may be operating in the brain," she said.

Modi's interest in the effects of glutamate receptor agonists led her to D-cycloserine (DCS), a drug formerly used to treat tuberculosis. CBN-supported research led by Mike Davis, Ph.D., and Kerry Ressler, Ph.D., of Emory University's School of Medicine found that DCS, an NMDA receptor mixed agonist that enhances synaptic transmission in the amygdala and other parts of the brain, enhances the extinction of conditioned fear in rats and some social phobias in humans. Inspired by the work of Drs. Davis and Ressler, Modi and Dr. Young found that giving DCS to female prairie voles promotes partner preference formation in female prairie voles under conditions in which social bonds do not typically form, suggesting that it enhances some aspects of social cognition.

"This is the first study to show that modulation of the glutamate system can enhance social bonding," Modi said. "We hypothesize that by enhancing glutatergic transmission in the nucleus accumbens, we are expediating the process of social learning, such that the application of DCS promotes the long term encoding of the rewards associated with social interaction. The drug has already been approved for use in humans, allowing our tests in voles to have direct implications for humans."

Further studies will explore the effect of a combination oxytocin and DCS therapy on the enhancement of social bonding in voles and as a therapeutic strategy to treat the social cognitive deficits in ASD.

Summer/Fall 2008

'Hub' of Fear Memory Formation Identified in Brain Cells

Center for Behavioral Neuroscience (CBN) scientists in the laboratory of Dr. Kerry Ressler have discovered that beta-catenin protein, an apparent "hub" for changes in the connections between brain cells, could be a potential target for drugs that enhance or interfere with memory formation. The results of the study are published in the October issue of *Nature Neuroscience*.

The beta-catenin protein acts like a Velcro strap, fastening the internal skeletons of cells to proteins on their external membranes, which in turn connect the cells with other cells.

"During long-term memory formation, structural changes take place in the synapses – the connections between neurons in the brain," says Kerry Ressler, M.D., Ph.D., associate professor

of psychiatry and behavioral sciences at Emory University School of Medicine, researcher at Yerkes National Primate Research Center, and a member of the CBN.

"We thought beta-catenin could be a hub for the changes that take place in the synapses during memory formation," says Ressler. "But because beta-catenin is so important during embryonic development, we couldn't take the standard approach of just knocking it out genetically."

To test beta-catenin's involvement in fear memory, Ressler and graduate student Kimberly Maguschak, a CBN Graduate Scholar, used a genetically engineered virus in mice to modify the beta-catenin gene in the amygdala, a part of the brain known to be involved in fear memory. Once a cell is infected, the virus inhibits the ability of the gene to make betacatenin protein. Mice who had been given the virus, along with control mice that had not, were exposed to a conditioned fear paradigm pairing an electric shock with an auditory stimulus (a tone) until the auditory stimulus produced a conditioned fear to the tone.

"We found that after beta-catenin is removed from the amygdala, the mice still learn to fear the shocks," says Maguschak. "But two days later, their fear doesn't seem to be retained because they spend half as much time freezing in response to the tone."

Injecting the virus after the learning process does not affect the ability of the mice to express the conditioned fear response. Therefore, beta-catenin appears to be necessary only during the initial learning and not in the "memory" of what is learned. Maguschak also found that when lithium chloride, a compound that can indirectly can block the destruction of beta-catenin protein, is given to the mice before the initial learning process, mice show an enhanced fear response to the tone two days later. She cautions that lithium is an imprecise tool for studying betacatenin because it affects several enzymes in the brain.

"Psychiatrists have used lithium to treat mania and bipolar disorder for decades, but how it works is not well-understood," Dr. Ressler says.

The authors suggest that medications that inhibit beta-catenin could transiently interfere with memory formation after trauma, helping to prevent learned fear responses such as post-traumatic stress disorder. Conversely, drugs that enhance beta-catenin function within the brain might serve as new therapies to treating disorders of memory, such as Alzheimer's disease. Unfortunately, at this time no drugs that target betacatenin are available except lithium.

Funding for the research came from the National Institutes of Health, the National Science Foundation, the Burroughs Wellcome Fund, the Center for Behavioral Neuroscience and the Yerkes National Primate Research Center.

Winter 2009

Research Results Could Lead to More Effective Pain Relief

According to the American Pain Foundation, pain affects more Americans than diabetes, heart disease, and cancer combined. The Foundation also noted more women than men reported experiencing pain, and treatment of pain in the pediatric population is inadequate compared to treatment for pain in adults.

Research in the laboratory of Anne Murphy, Ph.D., CBN member and a professor of neuroscience at Georgia State University, has led to breakthroughs in the understanding of pain that could put clinicians one step closer to more effective pain treatment for women and children.

One study, published online in *Pediatric Research*, by Murphy and Georgia State University graduate student Jamie LaPrairie, demonstrated that administration of preemptive morphine in infant rodents prior to a painful procedure blocks the longterm negative consequences of pain

(increase in sensitivity to pain and stress, and a decreased reaction to morphine) as adults. This means that infants undergoing invasive procedures at birth that do not receive adequate treatment for pain may require more medication in adulthood to moderate their pain.

While evidence exists that morphine is efficacious in neonatal rodents, this is the first study to confirm the long-term behavioral benefits of neonatal use of morphine. This study has serious implications for the way anesthetics and analgesics are administered to neonates prior to surgery and to adults with significant neonatal experiences of pain.

"This tells us that morphine might not work very well in human children and adults that were formally in the NICU and didn't receive preemptive pain treatment. Since morphine is still the primary drug used to treat severe pain, this means that there is an entire subpopulation for which morphine might not work efficiently," Murphy said. "These results also suggest that there are long-term benefits of providing newborns with some sort of pain relieving medicine prior to the initiation of an invasive procedure."

The results of another recent study by Murphy and Georgia State University graduate student, Dayna Loyd, Ph.D., show that previously reported differences in morphine's ability to lock pain in male versus female rats are most likely due to sex differences in mu-opioid receptor expression in a region of the brain called the periaqueductal gray (PAG).

Printed in the December 2008 issue of the *Journal of Neuroscience*, this study is the first to identify the most likely reason analgesic drug treatment is usually less potent in females than males.

"Opioid-based narcotics (such as morphine) are the most widely prescribed therapeutic agents for the alleviation of persistent pain; however, it is becoming increasingly clear that morphine is significantly less potent in women compared with men. Until now, the mechanism driving the phenomenon was unknown," Murphy said.

Located in the midbrain area, the PAG plays a major role in the modulation of pain by housing a large population of mu-opioid receptor expressing neurons.
Morphine and similar drugs bind to these mu-opioid receptors analogous to a 'lock and key' and, ultimately, tell the brain to stop responding to pain signals to the nerve cells resulting in the reduced sensation of pain.

"Interestingly, sex is not the only factor that has been shown to affect the potency of various pharmacological agents. Recent studies have reported an influence of age and ethnicity, and further argue for the inclusion of a wide range of study subjects in pain management research," Murphy said. "In addition, despite the rapidly mounting evidence regarding the limitations of opiates in treating persistent pain, opioid-based drugs remain the primary pharmacological tool for pain management. Clearly additional research with the inclusion of female subjects needs to be devoted to determining a more potent treatment for persistent pain in women."

The National Institutes of Health, Center for Behavioral Neuroscience, National Science Foundation, and the Georgia State University Brains and Behavior Program supported Murphy's research.

IV. EDUCATION

This section provides an overview of specific educational accomplishments over the 10-year tenure of the STC.

The overarching educational goal of the Center has been to foster the next generation of behavioral neuroscientists. To this end, the CBN implemented signature programs at the K-12,

undergraduate, graduate, and postdoctoral levels to migrate students through an educational pipeline into research careers in behavioral neuroscience.
Participation in all of our programs has remained high due to growing interest (based on applications/requests received).

During the past ten years, CBN scientists and educators have reached out to a huge number of K-12 students, providing both information and hands-on learning experiences about the brain and behavior. For example, through the Center's teacher professional development workshops we have reached over 220 K-12 science teachers providing them with information and tools to more effectively teach about neuroscience in their classrooms. In addition, scientists from the CBN have visited over 490 K-12 classrooms (18,000+ students) around the metro Atlanta area to share their excitement about neuroscience. More than 375 middle and high school students have participated in our summer Brain Camps and Institute on Neuroscience (ION) program, several of which have entered college at one of the CBN partner institutions and have participated in our undergraduate neuroscience programs. The assessment of impact that these programs have indicates a significant impact on general interest in learning more about neuroscience and neuroscience careers of those who participated.

At the undergraduate level, we have focused on initiatives attracting students to the research thrusts of the Center and providing access to neuroscience research experiences for undergraduates at all of our member schools. Since the development of these initiatives, the Center has exposed over 1000 undergraduate students to behavioral neuroscience and research careers, including more than 340 undergraduates who have participated in the summer BRAIN research program. Assessment of the BRAIN program participants indicates that many choose to pursue graduate study in some area of science, with the highest percentage choosing neuroscience as a field of study, indicating success in attracting more students into the field of neuroscience.

At the graduate and postdoctoral levels, the Center's collaborative approach to training has proven uniquely beneficial to those participating. In ten years, the Center has financially supported 73 graduate scholars and 33 postdoctoral fellows and has garnered participation from even more student and postdoc members who have also benefitted from the many non-financial resources offered by the CBN. In addition to receiving a uniquely broad, multi-disciplinary training, the CBN's graduate students and postdocs have access to multiple technologies that serve to advance their own research and help place them above their peers in research training and experiences. Graduate and postdoctoral participation has been critical for the completion of many of the venture grant projects and collaborative research throughout the Center. Center postdocs and graduate students are now spread across the nation, taking their training in how to conduct innovative collaborative research and education from the CBN into other institutions. Moreover, many of these postdocs and students continue to maintain collaborations with CBN investigators, thereby creating a virtual Center that extends across the nation.

Overall, the Center's pipeline approach has yielded unequivocally positive outcomes. The fact that students from across the nation apply to our programs indicates that the CBN has clearly become nationally recognized as a place for training in the neurosciences.

4.1. Summary of the Center's internal educational activities during the 10-year tenure of the STC

4.1.1. Postdoctoral Fellowship Program

The Postdoctoral Fellowship Program began in 2000 providing financial support to postdoc candidates who were recruited to work predominantly on collaborative research projects sponsored by the center's collaboratories. This program was designed to provide new postdocs with a greater breadth of training and to develop the skills for successful scientific collaboration. The center's postdoc fellows were also provided with access to teaching opportunities at partner institutions, to additional education through seminars, workshops and symposia sponsored by the CBN and other activities that promoted scientific exchange and fellowship among CBN members.

The postdoctoral fellows played a critical role in the collaborative endeavors of the center, providing some of the key labor and creative energy needed to develop and sustain new, innovative research collaborations. As the success of this program became apparent, many other postdocs working in CBN-affiliated laboratories expressed interest in being part of the center and, therefore, we established a Postdoctoral Membership status in 2004 that greatly expanded the popularity and influence of the CBN among our partner institutions.

Over the past 10 years, the CBN successfully recruited 33 CBN-paid postdoctoral fellows and 36 nonpaid postdoc members (i.e. supported by non-CBN funds) in nine years. Forty-seven have completed their postdoctoral training and most have gone on to become faculty members at major research institutions. Others have gone into a variety of alternative scientific or health-related positions including science journalist, FBI scientist, program officer at the CDC, and medical resident to name a few. Clearly, the postdocs matriculating through the CBN, whether as fellows or non-fellows, are going on to very successful careers, both traditional academic positions and alternative careers. Some of these postdocs continue to collaborate with CBN members, extending the collaborative scope of the center across the nation.

Activity Name	Postdoctoral Fellowship Program and Postdoc Members
Led by	Associate Director and CBN faculty
Intended audience	Postdocs in CBN labs
# Participants	**10-year total:** 33 CBN-paid postdoc fellows (10 female, 3 minority); 36 non-CBN-paid postdoc members (16 female)
Alumnus information	Of the 69 postdoc fellows and members, 47 have moved into other positions: 20 tenure-track faculty; 6 research faculty/non-tenured instructor; 6 are in second postdocs; 9 in alternative science/health-related careers; 6 changed from science/health careers or are currently on leave

4.1.2. Graduate Scholars Program:

The CBN's graduate education began with the CBN's Graduate Scholars program in 2001. This program was designed to provide financial support to graduate students already admitted to CBN-affiliated graduate programs who wish to conduct research in CBN faculty laboratories in an environment of collaboration among CBN investigators. This unique training environment provided a greater breadth of training and allowed students to develop the skills for successful scientific collaboration. Students in this program were provided with many opportunities for training and education through access to seminars, workshops and symposia sponsored by the CBN annually, courses that bring students from multiple programs and institutions together, participation in the CBN's collaboratory groups, and other activities that

promote scientific exchange and fellowship among CBN students from all CBN graduate programs.

Like the postdoctoral fellows, the graduate scholars played a critical role in the collaborative endeavors of the center, providing some of the key labor and creative energy needed to develop and sustain new, innovative research collaborations. Since that time, many other graduate students working in CBN-affiliated laboratories expressed interest in being part of the CBN and therefore we established a Graduate Student Membership status in 2004 that, as with the Postdoctoral Membership status, greatly expanded the popularity and influence of CBN training opportunities.

The Graduate Scholar's Program began with only six graduate students in 2001 and grew to a peak of 37 students in 2007. To date, 73 students have matriculated through this program. Forty-one of these have successfully completed Ph.D. degrees and have gone on to a variety of careers. The majority of these have pursued postdoctoral positions at major research institutions. Others have chosen alternative careers in science or health-related fields including public health administrator, science advisor in a law firm and physician, to name a few. The value of their training experiences in the CBN becomes evident as these former CBN students are recruited by some of the nations top research institutions. This speaks volumes about the success of this unique graduate training program.

Activity Name	Graduate Scholars Program and Graduate members
Led by	Graduate Committee Chair, Co-Director for Academic Programs
Intended audience	Graduate students in CBN-affiliated grad. Programs
# Participants	**10-year total:** 73 CBN-paid graduate scholars (29 female, 9 minority); 45 non-CBN-paid graduate student members (34 female, 2 minority)
Alumnus information	Of the 73 total graduate scholars, 56 have moved on from the CBN: 28 are in research postdocs; 3 are tenure-track faculty (1 teaching and 2 research); 8 have moved into alternative science/health-related careers 5 transferred out of the CBN-affiliated graduate programs into other graduate/medical programs; 4 completed M.S. degrees and changed to non-science careers; 8 left graduate programs before completing degrees or are on leave after completing their degrees (2)

4.1.3. Undergraduate Programs:

The Undergraduate education programs were designed to introduce undergraduates to the center's research thrusts through in-class instruction, seminars, internships, research symposia, and collaboratory meetings. The center faculty has played a major role in the development of new courses in behavioral neuroscience at most of our partner institutions and annually the center has provided unique training and networking opportunities to many undergraduate students interested in neuroscience as a career choice.

Much of the success of the center's efforts to recruit undergradutae students into neuroscience is due to the CBN's signature undergraduate research program, BRAIN

(Behavioral Research Advancements in Neuroscience). For BRAIN program recruitment, we have developed a systematic strategy to build a critical mass of undergraduate students (especially female and underrepresented minority students) interested in careers in behavioral neuroscience. Our strategy continues to include hosting recruitment events at our partner institutions, recruiting widely through specially targeting departments in other colleges and universities, recruiting via on-line mechanisms such as Facebook, and by providing academic-year undergraduate mentoring and research opportunities in the labs of CBN faculty. This approach has proven to be a successful model for exposing students to behavioral neuroscience and stands as an important interface to the new and extant behavioral neuroscience concentrations, minors and majors at Center institutions.

In 2009, a significantly enhanced effort was directed toward the BRAIN program. Dr. Kyle Frantz, Associate Professor of Biology at Georgia State University was awarded an educational research grant from NIGMS to study the comparison of two models of summer neuroscience research. Importantly, this grant was piloted with supplemental funding to Dr. Frantz provided by the NSF through the STC program in 2005. This project compares the traditional BRAIN summer experience (known as the AM-apprenticeship model-) with the CLM- Collaborative Learning Model-which places BRAIN Fellows into teams of 3 and 4. These teams work on the development of a research question and grant proposal after several weeks of neuroscience laboratory experiences on a variety of topics and research skills. The NIGMS support allowed an expansion of the participant total to 38 students in BRAIN 2009.

The popularity of this program is evident in the large numbers of applications received each year. In 2009, approximately 150 files were reviewed (incomplete applications were not reviewed). Forty participants were invited as Fellows and 34 were waitlisted. The BRAIN program began this year with a one-week intensive orientation during the last week of May. Fellows then worked daily in research labs (either in their mentor's lab if they were part of the AM or in common labs at the Georgia Institute of Technology if they were part of the CLM). All Fellows met once a week on Thursdays at Yerkes National Primate Research Center for half-day seminars designed to round out the research experience. Topics included: preparation for graduate school, bioethics, scientific entrepreneurship, poster and paper preparation and literature researching tools in the library. The summer BRAIN program culminated with a Research Symposium where each Fellow had the opportunity to present his/her research during a poster session.

As reported by Dr. Frantz, the main research questions for the NIGMS study over the 4 years (2009-2021) are:

- Does a Collaborative Learning Model (CLM) for an undergraduate summer research program positively affect student self-efficacy, mastery of science content and process skills, and career progress to the same or greater degree than a traditional Apprenticeship Model (AM)?
- Why, how, and for which student subpopulations does the program produce positive outcomes (or fail to do so)?
- Is our program delivered, received, and evaluated as intended?

The NIGMS research was designed to collect participant data on a number of variables of interest including

- Research skill self-efficacy
- Leadership self-efficacy
- Science anxiety

- Neuroscience anxiety
- Confidence with neuroscience concepts

Data were collected this year at pre-, mid-, and post-participation through a mix of quantitative and qualitative methodologies including:

- Interview and focus group discussion protocols developed de novo
- "Daily Puzzlers" (content quizzes) developed as probes of achievement
- Rubric designed to evaluate final research papers (proposals or reports)
- Online surveys
- Interviews and focus groups

The 2009 data are currently being analyzed and there is intent to provide results later in early 2010. All of the current data will be aggregated with subsequent years' data.

Activity Name	BRAIN (Behavioral Research Advancements in Neuroscience)
Led by	Deputy Director for Education
Intended audience	Undergraduate students
# Participants	**10-year total:** 341 (>60% underrepresented minority and >65% female)

In addition to the BRAIN program, the center's Undergraduate Education Committee continued to work towards the development of a more cohesive and inclusive community that embraces, encourages, and supports undergraduate students who have academic and career interests in neuroscience. The UEC sponsored an event again in the fall of 2009 that highlighted research done in CBN laboratories and at the Zoo. Participants learned more about current issues in behavioral neuroscience, had dinner together, and the event also allowed the development of community building among the students across the various institutions represented in the CBN. The event was advertised tdirectly to the more than 350 undergradutes working in CBN labs and to students in neuroscience and related majors at all CBn institutions. Nearly 75 undergraduates from most of the center's partner institutions attended the event and had an opportunity to meet and mingle with CBN faculty, other undergraduates with similar interests and BRAIN program alumni.

Since October 2007, the UEC partnered with PURC (Psychology Undergraduate Research Conference) sponsored by Georgia State University, to provide an additional opportunity for the CBN undergraduates to showcase their own research. In November 2008, 14 of the 31 posters presented were by students from CBN labs two of whom were former participants in the BRAIN 2008 summer program. CBN collaborated again with PURC in the fall of 2009 providing opportunities for posters in behavioral neuroscience from CBN labs.

4.2. Summary of the Center's <u>external educational activities</u> during the 10-year tenure of the STC.

K-12 Educational Programs

Activity Name	Brain Bee
Led by	Associate Director + volunteers
Intended audience	High school students
# Participants	**10-year total:** 267
	(demographic data not collected)

Activity Name	Institute on Neuroscience
Led by	Dr. Kyle Frantz, CBN Science Educator
Intended audience	High school students
# Participants	**10-year total:** 75 (approx. 25% underrepresented minority and approx. 60% female)
Activity Name	Brains and Behavior Teacher Workshop
Led by	Dr. Laura Carruth, CBN Science Educator
Intended audience	K-12 science teachers
# Participants	**10-year total:** 217 (27% underrepresented minority; 87% female)
Activity Name	Brain Camp
Led by	Dr. Laura Carruth, CBN Science Educator
Intended audience	Rising 5th through 8th graders
# Participants	**10-year total:** 314 (approx. 50% underrepresented minority and approx. 40% female)
Activity Name	Neuroscience Exposition Reverse Science Fair
Led by	Dr. Kyle Frantz, CBN Science Educator
Intended audience	Renfroe Middle School students
# Participants	**10-year total:** 867 (approx. 70% underrepresented minority);
Activity Name	Brain Awareness Month classroom visits
Led by	CBN members
Intended audience	K-12 students
# Participants	**10-year total:** 560+ classroom visits reached 27,000+ K-12 students **Current total:** 70 classrooms; 50 volunteers; reached 8200+ K-12 students

Brain Bee: As the CBN's funding ends in 2009, sponsorship for the 2009 Georgia Regional Brain Bee was taken over by the Atlanta Chapter of the Society for Neuroscience (ACSFN) and co-sponsored by the CBN. This year 21 students from local and regional high school participated and the first place winner was sent with one parent to the national competition. This local competition continues to be a great way to introduce these students to our high school and undergraduate programs. To date we have had approximately twelve students who participated in the Brain Bee apply for and participate in the ION program (see below).

Institute on Neuroscience (ION): The Institute on Neuroscience (ION) is an eight-week summer program for exceptional high school students. The aim of the program is to develop the scholars' skills in problem solving, critical thinking, hypothesis formation, laboratory

experimentation, and scientific communication. The program combines a formal lecture series with a laboratory apprenticeship. The ION scholars are initially immersed in an intense basic neuroscience curriculum, which is enhanced by hands-on activities (three week orientation component of the program). Subsequently, scholars are mentored in active university research laboratories where they engage in meaningful and exciting experimentation (five week research component). Projects culminate in oral presentations of research findings. Weekly workshops on scientific ethics, science writing, stress reduction techniques, and oral presentations familiarize scholars with survival skills for the scientific community. In 2009, ten ION Scholars from metro Atlanta started and completed the program. Five scholars were women (50%), two scholars were under-represented minority students (African American; 20%) and five were Asian American (50%). These ten scholars were chosen from 64 applicants (44% female; 20% African American; 2% Hispanic; 50% Asian; 25% Caucasian). The ION program was evaluated with a Post-Program survey conducted on-line to query participant attitudes toward science, attitudes toward neuroscience, confidence with neuroscience concepts, and confidence with research-related skills. On the Mid- and Post-Program Surveys, the value and benefits of program components (lecture topics, lecturers, assistants, field trips, etc.) are also queried. Retrospective analysis of program impact continued this year with implementation of an on-line survey for all program alumni (N=53), but only about 50% responded. Methods to improve alumni response are under investigation.

Teacher workshops: In order to produce systemic changes in science education in the Atlanta-area schools and effectively use the teaching resources that have been developed by the CBN, we have put emphasis on building a cohort of science educators to serve as conduits between institutions of higher learning and public schools. The strategy to achieve this has been to equip science educators with the knowledge and resources to develop innovative learning experiences that convey excitement for science and science careers. To this end, Dr. Laura Carruth facilitated our annual one-week extended contact professional development workshop held at Zoo Atlanta from June 8th-12th 2009, for 13 1st-12th grade Georgia science teachers (11, female, 2 male and 23% minority). This teacher workshop requires extended contact and includes two single-day follow-up sessions scheduled for Dec. 5, 2009 and mid-Spring 2010. The workshop concentrates on the neuronal and endocrine controls of behavior focusing on examples from maternal, reproductive, aggressive and social behavior. We provided the teachers with college level content in addition to having them participate in discussions with zoo researchers, spend time observing zoo animals and develop and using ethograms. The workshop awards either 4 or 5 Professional Learning Units (PLUs) depending on the depth of the lesson plan developed and the number of additional contact hours they participate in. All Georgia teachers need to earn PLU credits in order to maintain their certification. In addition, Dr. Carruth has been visiting the classes of most of the teachers in the Fall 2009 and will continue to do so in Spring 2010 as the teachers present their lesson plans to collect data on lesson plan development and how the material are used in the classroom. Teachers were supplied with an animal behavior textbook, a student workbook that they can use in their classrooms and a notebook of workshop material developed by L. Carruth. In addition, $200 in supplies were purchased for each teacher to help facilitate the development and implementation of their lesson plans. Pre- and post-material content and science attitudes evaluations were filled out on the first and last day of the workshop and this data is currently being analyzed.

Brain Camps: During summer 2009, we offered one Brain Camp for rising 5th-rising 8th grade students July 20th-24th, 2008 (8:30am-5:00pm) at Renfroe Middle School in the city of Decatur. We had 32 children (this includes 2 junior counselors who were students who attended the camp in 2008) participate in the camp (35% minority; 30% female, one special needs student). All students were from local schools, with 29 of the 32 campers from schools in the City Schools of Decatur district. The camp curriculum was designed around the 7th grade Life Science Georgia Performance Standards. Neuroscience lessons and activities included sheep brain and mammalian eye (cow, sheep and pig) dissections, sensory system experiments, learning about brain nutrition and health, brain diseases and disorders, and learning and memory, neurotransmission activities. On the last afternoon of the camp we hosted an open-house for the families of the campers so the students could demonstrate to their parents and other attendees what they had learned during the week. This camp was our third camp partnering with the City Schools of Decatur, which we hope to continue. The camp also received support from the Dana Alliance for Brain Initiatives allowing the CBN funds to support the hiring of six camp "counselors", teachers and neuroscientists from CBN institutions, who helped run the camp. Two of the teacher/counselors are teachers at Renfroe Middle School and we used their classrooms for the camp. Campers received goody bags full of neuroscience-related educational materials at the end of the week. Pre-and post-neuroscience content and science attitude data was collected on the first and last days of the camp.

Neuroscience Exposition (reverse science fair): The biggest event of Brain Awareness Month is our Neuroscience Exposition. The Expo features interactive booths at which short neuroscience lessons engaged students in topics ranging from neurons and neurotransmission, to brain anatomy and imaging, to learning, memory, and behavior modification. Booths were designed and presented by a volunteer corps of post-doctoral fellows, graduate and undergraduate students. In 2008, 15 of these volunteers worked with K. Frantz (Expo Director) to earn internship credit at GSU for designing, implementing, and evaluating Expo booths. In 2009, a cohort of seventh-grade students from the City Schools of Decatur, Renfroe Middle School (n=147) visited the Expo and participated in a day-long program featuring a "reverse science fair" in which students judge the neuroscience teaching booths based on their effectiveness and fun. As we have since 2005, we also visited classrooms before the 2009 Expo field trip. Half the classes participated in a brain-related lesson before the Expo, while half participated in an unrelated lesson (about the heart). Early data analysis indicated that attention and interaction at the Expo increased among students who did preliminary work related to the brain, compared with students who learned about the heart. Later attempts to replicate the finding have not revealed any effect of pre-Expo lesson plan on attention or interaction at the Expo. This work suggests that in-school preparation may enhance the impact of field trips in a manner dependent on school environment. [NOTE: In 2005 and 2006, all students were from Charles Drew Charter School and were 99% of student participants were African American and 99% qualify for free or reduced shool lunch. The Charles Drew School did not commit to working with the CBN for this event in 2007. Therefore, the 2007 -2009 cohorts came from City Schools of Decatur, reporting 45% students from under-represented ethnic/racial groups (African American, Latino) students at their school and only 30% qualifying for free or reduced lunch.]

K-12 Classroom Visits: Also during Brain Awareness month, the CBN partnered with the

Atlanta Chapter of the Society for Neuroscience (ACSfN) to lead over 70 classroom visits with more than 50 CBN and ACSfN volunteers to teach neuroscience in K-12 classrooms. Our estimates are that over 8200 students were reached in these school visits. Our primary objectives continue to be building on the success of previous years by continuing to increase the diversity of schools visited and to increase the availability and access to curriculum materials. Volunteers were paired with schools requesting visits and arranged with the schools what they would be presenting and when. Curriculum materials are made available for volunteers though the ACSFN and Center for Behavioral Neuroscience websites and the CBN's Lending Library.

V. KNOWLEDGE TRANSFER SUMMARY

This section provides an overview of specific knowledge transfer accomplishments over the 10-year tenure of the STC.

The CBN's knowledge transfer activities are designed primarily for public education about the center's research and about neuroscience in general. Through the center's 10-year history we have worked with a number and variety of partner organizations to achieve excellence in public education. The center's primary partners in these efforts have been Zoo Atlanta, the Fernbank Museum of Natural History and the Atlanta Chapter of the Society for Neuroscience. However, other partnerships have also yielded some unique opportunities for public education and visibility for the CBN.

In partnership with Zoo Atlanta, center members have helped create 3 very popular exhibits at the Zoo designed to show the general public how research enhances our understanding of animal and human behavior. In 2005, with funding from a CBN venture grant, Zoo Atlanta and the CBN partnered to add a new interactive element to the gorilla exhibit at the Zoo. An interactive "panel" allows animal trainers to interact with the gorillas directly through a steel mesh screen while the public observes and learns. In addition, the CBN and Zoo created a video that explains the research ongoing with gorillas, both at the Zoo and in the field. As part of our commitment to understanding reproductive behavior, the CBN played an important role in the birth of a rare panda cub at Zoo Atlanta in 2006. The laboratory of Dr. Elliott Albers, CBN Director, ran essential hormone assays used to determine the critical 3-day mating period for the pandas at the Zoo and also to determine the possibility of pregnancy following the mating period. In 2008 we introduced a new cognitive testing environment in the Zoo's orangutan exhibit that includes a touch screen computer built into a tree structure in an outdoor setting where Zoo visitors can watch live research being conducted. In addition, the viewing area includes a video monitor on which visitors will be able to see a video describing the research process and there is a human version of the touch-screen computer on which visitors can test their own cognitive abilities and compare them to the orangutans. These exhibit enhancements are providing new ways of educating the public about gorilla, orangutan and panda behavior and the importance of research in understanding their behavior.

Atlanta has become famous for CBN's annual Brains Rule! Neuroscience Exposition. In partnership with Zoo Atlanta, CBN has reached thousands during the spring Exposition, the largest public neuroscience education event of its type in the country. At the Expo, children and adults alike learn about the brain and behavior through interactive booths on a range of topics from brain anatomy to learning and memory. The Expo is put together and run by a large contingency of faculty, postdoc, graduate and undergraduate student volunteers from the CBN so that visitors to the Expo get to talk to "real" scientists. Over the history of this annual event,

more than 15,000 members of the general public were exposed to interactive learning booths covering a wide variety of topics related to neuroscience. In 2009, due to budget cuts, we decided to focus our resources on the reverse science fair portion of the Expo for middle school students. During this portion of the event, middle school students from a local school district are assessed before and after exposure to several select interactive learning segments at the Expo. Assessment of this event helps to determine how these one-off, informal types of learning experiences influence what students learn and how excited they become about science. Over the years it has become clear that they do have a positive impact, at least in the short-term.

Between 2004 and 2008, the Center partnered with Fernbank Museum of Natural History to host our popular "neuroscience in the movies" events approximately twice annually. These events were extremely well-received by the general public, providing the CBN with valuable public exposure while educating the public about human neuroscience as portrayed in a variety of popular movies. Short presentations by center scientists provided more detailed information about the topic featured in the films and allowed the public participants a chance to ask their questions of a real scientist. In 2009, sponsorship of the movie events was taken on by the Atlanta Chapter of the SFN.

For several years the Fernbank Museum also served as the location for the Georgia Regional Brain Bee sponsored by the CBN. This event has become a useful service to local students who wish to participate in this event and has provided visibility for the CBN. Many students who participated in the Brain Bee went on to participate in other educational programs sponsored by the center, including our undergraduate programs. As with the movie events, the Brain Bee is now solely sponsored by the Atlanta Chapter for the SFN and held in a different location.

The Fernbank Museum also partnered with the CBN to provide a unique docent training program to a small group of undergraduate students in conjunction with the Genomics Revolution traveling exhibit in 2004. Postdoctoral researchers developed and led an in-depth, comprehensive undergraduate docent training program in genomics and assisted the students in developing lay language to "teach" basic concepts about genomics to the general public who visited the exhibit. In addition, the students led simple wet labs as part of the exhibit to provide the public with hands-on learning about some of these basic concepts. The project was extremely well-received by the public and an enjoyable experience for the students who participated as docent teachers.

Each year for Brain Awareness Month the CBN partners with the Atlanta Chapter of the SFN to take scientists out into Georgia K-12 classrooms to excite these students about neuroscience. With the aid of the resources of the CBN's Lending Library and the AC-SFN's pre-packaged class presentations, we have put neuroscientists into more than 490 K-12 classrooms. These K-12 students are given a glimpse into the exciting world of neuroscience and we share information about our K-12 programs to which we invite them to apply. Our estimates are that more than 18,000 K-12 students and teachers were reached through these visits over the history of this program. The AC-SFN will continue to provide sole sponsorship and organization of the annual classroom visitation program and the Lending Library, which is heavily used for these classroom visits.

VI. EXTERNAL PARTNERSHIPS SUMMARY

This section provides an overview of specific external partnership accomplishments over the 10-year tenure of the STC.

Partnerships with some educational organizations that involve a large part of our knowledge transfer efforts are described above under the Knowledge Transfer section. Our primary goals for our other external partnerships are to use these partnerships to promote neuroscience within the educational system, to provide new training opportunities and professional connections for our own students and postdocs.

These partnerships include an annual graduate student-postdoc exchange with the Keck Center for Behavioral Biology (N.C. State University) and the Center for Intellectual Study of Animal Behavior (Indiana University). The CBN awards 2 graduate students/postdocs travel awards to attend and present data at the annual research symposia of the Keck Center and CISAB. In turn, the CBN hosts 4 students/postdocs from these centers at our annual symposium. This partnerships allows students/postdocs the opportunity to present their research in a professional environment and to expand their professional contacts in the field. It was through this exchange program that one of our former graduate students developed a connection and secured her current postdoc position at the Indiana University. In addition, this relationship attracted two of our former postdoc members to faculty positions at N.C. State University.

Our partnership with GeorgiaBio focuses on bridging the biosciences and business in the academic environment. This partnership has also provided the CBN with unique access to local business leaders who are interested in promoting science education. This partnership is bringing scientists and business people to the table to discuss unique ways to promote science and science education in the state of Georgia. We hope that partnerships between the CBN and the local bioscience industry will develop from this endeavor.

In 2007, Georgia Bio and the CBN partnered to develop and offer a new undergraduate course aimed at undergraduate students educating them about the connection between bioscience and business. The course featured CEOs from the local biosciences industry as the lecturers. The course brought together undergraduate science and business students from our partner institutions allowing them to form new connections with one another.

In 2008, this partnership resulted in funding for a new initiative to provide K-12 teachers in Georgia with better training and curriculum materials for many areas of science and technology. The Center's teacher workshop program for behavioral neuroscience was included in this initiative that received congressionally-directed funding.

VII. DIVERSITY SUMMARY

This section provides an overview of specific diversity accomplishments over the 10-year tenure of the STC.

Over the 10-year history of the CBN, we made great strides in diversity among our own membership compared to the national averages as reported in the ADNP surveys. The level of diversity in the center has remained consistent over the past year. Our K-12 programs typically target schools in metro Atlanta where close to 50% of the students are minorities. We have continued to see a large number of minority students, many from the AUC institutions, and female students matriculating through CBN laboratories and attending CBN undergraduate seminars. Thus, our K-12 and undergraduate programs remain highly diverse. We have also seen success in recruiting minorities and females into our graduate program. However, we have seen less success in recruiting minority postdocs and minority faculty. It is clear that the incentives that we have offered are not enough to change this trend and a larger effort involving

the entire field of science and the academic community will be necessary to make further inroads. By comparison with the national averages for similar academic programs (ADNP survey), however, we were able to equal or surpass the national averages for female and minority participation at the graduate, postdoc and faculty levels during the past five years (decrease this past year in a few categories due to reduction in funding).

Table 1: Demographic breakdown of CBN members across institutions compared with ANDP averages for neuroscience (from 2005 ANDP survey of Neuroscience degree programs, the last completed survey, see: http://www.andp.org/surveys/surveys.htm).

*reflects only those financially supported by CBN	Total	Female (CBN)	Female (National)[1]	Underrep. Minority (CBN)	Underrep. Minority (National)[1]
Faculty	104	41 (39%)	25%	11 (11%)	8%
Postdoc Fellows*	6	2 (33%)	41%	2 (33%)	8%
Grad Scholars*	18	13 (72%)	56%	2 (11%)	16%
Undergrads*	38	26 (68%)	n/a	5 (13%)	n/a

[1]From 2005 ADNP survey

As noted previously CBN used a "pipeline and pathway" approach to increasing women and minority participation in careers in behavioral neuroscience and fields where advanced training in neuroscience and behavior is needed. To expand the pipeline, we began to educate K-12 children about neuroscience and behavior and expose them to related careers. At the undergraduate level, where many minorities and women primarily consider medical school, we exposed freshman and sophomore students to opportunities to learn about and conduct research in behavior and neuroscience. Based on the numbers above, we believe that we have done quite well in recruiting some of the brightest minority students into CBN-affiliated graduate programs and helping them to move into research careers. However, many other factors outside of the CBN (family and social pressure) have far greater effects on minority career choices.

VIII. MANAGEMENT SUMMARY

This section provides an overview of the post-NSF funding management of the center to help ensure its continued operation

As of the end of the NSF funding for the CBN, all the center staff members have been successfully transitioned into permanent positions. Most no longer have a primary role with the CBN; however, with funding provided to the center in perpetuity by Georgia State University, critical staff positions will be able to remain and provide some percent effort towards maintaining the basic operations of the CBN. Specifically, the Associate Director will retain authority to maintain general operating procedures with the assistance of the Communications Coordinator and Information Technology Director. These key positions will allow the center to continue to provide communication with the membership, manage collaborative research activities, identify and pursue new funding, and generally provide the basic administrative "glue" needed for a cohesive center operation.

IX. CENTER WIDE OUTPUTS AND ISSUES

9.1. List all Center publications in the reporting period using a standard citation format.
(due to the large number of publications, we are attaching these in Appendix C)

Year	#Faculty	# Publications	# w/multi-labs-not CBN	# w/multi-CBN labs	# CBN funded
2008-2009	105	454	171	38	97
2007-2008	107	350	170	37	44
2006-2007	104	299	109	39	69
2005-2006	93	365	128	50	83
2004-2005	91	331	172	36	65
2003-2004	89	99	54	27	53
2002-2003	91	103	51	22	32
2001-2002	78	58	34	22	17
2000-2001	48	32	22	15	8
1999-2000	30	1	0	1	1

9.2. List all Center conference presentations in the reporting period using a standard citation format.
(due to the large number of presentations, we are attaching these in Appendix C)

Year	#Faculty	#Presentations	# w/multi-labs-not CBN	# w/multi-CBN labs	# CBN funded
2008-2009	105	460	53	55	132
2007-2008	107	321	49	44	60
2006-2007	104	426	65	41	111
2005-2006	93	396	58	36	120
2004-2005	91	325	105	56	119
2003-2004	89	178	82	60	89
2002-2003	91	111	42	34	51
2001-2002	78	67	26	18	25
2000-2001	48	29	13	10	10
1999-2000	30	None reported			

9.3. Other dissemination activities not included elsewhere in the report during the reporting period.

9.3.1. Grants seeded by Center funds (2008-2009)

Albers
NSF, July 1 2009 thru June 30 2013

Bachevalier
NIMH R-01, 08/01/1998 - 07/31/2010
NIMH R-21, 8/01/09 – 7/31/14
NIMH R-21, 7/1/08 - 6/30/10
NIH Base Grant (Yerkes primate Center) RR00165, 6/01/08-5/31/10

Bartness
NIH Merit Award, R037 DK35254-26 to 36, 08/01/09-07/31/19
NSF, 06/01/03-09/30/09
NIH R01 DK077975-01-05, 01/15/09-12/31/13

Brosnan
NSF Career Award, SES 0847351, 2009-2014

Davis
NIMH 1R21MH086947-01, 7/01/09 - 6/30/11
NIMH 1RC1 MH088985-01, 09/30/09 - 9/29/11

Frantz
Medical University of South Carolina Pilot Grant, 7/2009-6/2010
Georgia State University Scholarly Activity Grant, 2009
Georgia State University Brains & Behavior Seed Grant, 7/2009-6/2010

Huhman
NIH RO1 MH62044, 2007-2012

Katz
NSF ISO-0814411, 2008-2012
NSF IIS-0827418, 2008 – 2010

Keilholz
1 R21NS057718-01, 2009-2011

Liu
NIH R01 DC008343-03S1, 7/09-6/11

Mayberg
NIH PAR-07-159, 9/1/2009-8/31/2014
1U19 MH069056, 07/01/08 - 06/30/13

Miller
NIMH 1R01MH083746-01A1, 06/08/09-3/31/13

Norrholm
NARSAD, 7/1/2008-6/30/2010
Dept. of Defense, PT075434, 7/1/2008-6/30/2012
Emory University, 1/1/2008 – 1/1/2009

Rilling
RO1 MH084068-01A1, 8/1/09 – 7/31/13

Ressler
NIH / 1RC MH088467-01, 09/30/2009 – 08/31/2011

Rothbaum
Department of Defense, 2009-2011
NIMH R34 MH083078-01A1, 7/11/2008- 6/30/2011

Sanchez
NIMH 1 P50 MH078105, 03/01/2009-02/27/2014

Thomas
1RC1GM090950-01, 09/30/09 – 08/31/11

Wilczynski
NSF, 4/1/08-3/31/12
Templeton Foundation, 1/1/09-12/31/09

Young
NSF OISE-0836799, 9/15/09-8/31/2011
McKnight FoundationTechnological Innovations in Neuroscience, 8/1/09-7/31/11

Postdoctoral
Choi
NIMH, Ruth L. Kirschstein NRSA, 2009-2011

Predoctoral
Mascaro
National Center for Complementary and alernative Medicine NRSA, 2008-2011
Modi
Emory Neuroscience Initiave Award, 2009

9.3.2. List all awards and other honors with names of those honored and source in the reporting period.
Albers
Georgia State University Community Service Award, 2009

Anderson
Award and Honorary Membership for Infusing Diversity into Teaching, Society for Teaching of Psychology, American Psychological Association, 2008

Bachevalier
Elected Fellow of the American Association for the Advancement of Sciences (AAAS), Neuroscience Section, 2009

Bartness
NIDKK MERIT award

Bauer
Cognitive Development Society Book of the Year, 2007, *Remembering the times of our lives: Memory in infancy and beyond*. Mahwah, NJ: Erlbaum.

Brosnan
NSF Career Award, 2009-2014
Herbert H. Reynolds Outstanding Young Alumni Award, Baylor University Alumni Association, 2009
Chosen as one of the most influential 150 alumni from the last 150 years of the Baylor University Alumni Association, 2009

Chang, Y-P
NSF Career Award, 2009

Davis
2008 "Distinguished Friend to Behavior Therapy" Award, Association of Behavioral and Cognitive Therapies

Duarte
Elected to the International Society for Behavioral Neuroscience, May, 2009

Goodman
Elected to American College of Neuropsychopharmacology (ACNP), 2009

Hu
Fellow, Institute of Electrical and Electronic Engineers, 2009
Fellow, American Institute of Medical and Biological Engineering, 2009

Jackson
Vice Chair for Board of Directors Zoo Atlanta, 2009

Kubanek
Georgia Tech Faculty Woman of Distinction Award, 2009
Georgia Tech College of Sciences Faculty Mentor Award, 2009

Kuhar
Fulbright Award for Chile, South America, 2008

Levey
Best Doctors in America, 2009

Lu
Invitee to participate in the US Frontiers of Engineering Symposium, National Academy of Engineering, 2009
Sigma Xi Young Faculty Award, Georgia Tech, 2009
Sloan Foundation Fellowship in Neuroscience, 2009

Maney
HHMI Distinguished Mentor Award, 2009

Mayberg
Raymond Adams Lecture, American Neurological Association, 2009
Frontiers in Clinical Neuroscience, Academy of Neurology, 2009
Elected, Institute of Medicine, 2008

Moore
U.S. Fulbright Fellowship, 2009

Ressler
Freedman Award for basic research by NARSAD, 2009

Young
Golden Brain Award, Minerva Foundation, 2008
Elected as Member, American College of Neuropsychopharmacology, 2009
Darwin Merit Award Medal from Universidad Veracruzana, Xalapa, Mexico, 2009

Postdoctoral
Black
Society for Neuroscience Next Generation Postdoctoral Award, 2009

Choi, D.
Society for Neuroscience Postdoctoral Travel Award , 2008

Ditzen
Award for the best scientific presentation, Symposium of the German Health Psychology Association, 2009
Peer Mentoring Fellowship, University of Zurich, 2009
Young Scholars Award, American Psychosomatic Society (APS), 2009

Gutman
APIRE/Janssen Resident Research Scholar, 2008
American Society of Clinical Psychopharmacology Travel Awardee to attend 2008 Clinical Trials Meeting, 2008
2009 Daland Fellowship in Clinical Investigation from the American Philosophical Society, 2009

Resident Research Award Emory University, 2009

Heldt
NARSAD Young Investigator Award, 2009

Predoctoral
Ahern
Emory University - Dean's Teaching Fellowship, 2009-2010.

Doherty
Symposium for Young Neuroscientists And Professors of the SouthEast (SYNAPSE) student travel award, 2009.
Teaching Award, Outstanding Teaching Award, GSU Biology Department, 2009.

Heimbauer
Language and Literacy Fellowship, Georgia State University, 2008, 2009
American Society of Primatologists Conference Travel Award, 2009

Miles
International Behavioral Neuroscience Society Travel Award, 2009
Carl Storm Underrepresented Minority Fellowship Travel Award for Amygdala in Health & Disease Gordon Research Conference, 2009
Travel award to attend the NIH National Graduate Student Research Festival, 2009

Schwarb
President's Fellowship, Georgia Institute of Technology, 2009
Graduate Student Research Symposium Grand Prize Winner, Georgia Institute of Technology, 2009

Smith
Society of Radiopharmaceutical Sciences Travel Award, 2009

Victoria
Early Life Programming Conference Travel Award, 2009

9.3.3. List any CBN-funded M.S. and Ph.D. students who graduated during the reporting period, with placements. Include the number of years taken since entering graduate school to complete the Ph.D. List postdoctoral associates who left the STC during the reporting period, with placements.

Name	Degree	Years to Degree	Placement
Myers, Karyn	Postdoc	N/A	Postdoc at McLean Hospital/Harvard
Nguyen, Mary	Postdoc	N/A	On leave
Bauzo, Rayna	Grad.	7	Postdoc, University of Florida
Donaldson, Zoe	Grad.	6	Postdoc at Columbia University

Gutzler, Stephanie	Grad.	6	Pending postdoc position
LaPrairie, Jamie	Grad.	4	Postdoc at Emory University
Leung, Cary	Grad.	5.5	Postdoc at Emory University
Lorenzi, Varenka	Grad.	6	Postdoc at UC Riverside
Ross, Heather	Grad.	7	Postdoc at Emory University
Ryan, John	Grad.	5	Postdoc at Univ. of Pittsburgh

9.4. List, to the extent known, the <u>general outputs</u> since the last reporting period.

Patent Name and Inventors	Number	Application Date	Receipt Date
Charles Derby, GSU "Synergistic antimicrobial molecules"	Provisional Patent # 61/083,790	7/28/2008	Pending
Julia Kubanek – Ga. Tech. "Antimalarial activity of bromophycolide natural products: *Neurymenia fraxinifolia*"	Provisional Patent # 61/151,952	2/12/09	
Julia Kubanek – Ga. Tech. "Antibacterial neurymenolides from the Fijian red alga"	Provisional Patent # 61/113,732	11/12/08	
Hang Lu –Ga. Tech. "Systems and methods for high-throughput detection and sorting"	Patent application PCT/US08/76869	9/18/08	

9.5. List all participants in the Center activities classified by the categories and demographic characteristics listed below the table. Center affiliates may also be included in this table, but MUST be distinguished from participants.

9.5.1. FACULTY

Name	Dept. and Institution	Gender	Ethnicity/Race	Disability	Citizenship
Albers, Elliott	Biology, GSU	M	Caucasian	None	U.S.
Alvarado, Maria	Yerkes, Emory	F	Hispanic	None	U.S.
Anderson, Page	Psychology, GSU	F	Caucasian	None	U.S.
Bachevalier, Jocelyne	Psychology, Emory	F	Caucasian	None	U.S.
Bartness, Tim	Biology, GSU	M	Caucasian	None	U.S.
Bauer, Patricia	Biology, Spelman	F	Caucasian	None	U.S.
Bradley, Dolores	Psychology, Spelman	F	African Amer	None	U.S.
Brosnan, Sarah	Psychology, GSU	F	Caucasian	None	U.S.
Buffalo, Elizabeth	Neurology, Emory	F	Caucasian	None	U.S.
Carruth, Laura	Biology, GSU	F	Native Amer	None	U.S.

Chang, Tina	Psych, Morehouse College	F	Asian Amer	None	U.S.
Chang, Young-Hui	Physiology, Ga. Tech.	M	Asian	None	Perm. Res.
Clancy, Andrew	Biology, GSU	M	Caucasian	None	U.S.
Clemens, Stefan	Biomed. Eng., Ga. Tech.	M	Caucasian	None	Perm. Res.
Davidson, Alec	Neuroscience, MSM	M	Caucasian	None	U.S.
Davis, Michael	Psychiatry, Emory	M	Caucasian	None	U.S.
Derby, Charles	Biology, GSU	M	Caucasian	None	U.S.
DeWeerth, Steve	Elec. Computer Engineering, Ga. Tech	M	Caucasian	None	U.S.
Dhamala, Mukesh	Psychics, GSU	M	Asian	None	Perm. Res.
Duarte, Audrey	Psychology, Ga. Tech.	F	Caucasian	None	U.S.
Duncan, Erica	Psychiatry, Emory	F	Caucasian	None	U.S.
Edwards, David	Psych, Emory	M	Caucasian	None	U.S.
Edwards, Don	Biology, GSU	M	Caucasian	None	U.S.
Ehlen, Chris	Neuroscience, MSM	M	Caucasian	None	U.S.
Ford, Byron	Neuroscience, MSM	M	African Amer	None	U.S.
Frantz, Kyle	Biology, GSU	F	Caucasian	None	U.S.
Fukuhara, Chiaki	Neuroscience, MSM	F	Asian	None	Perm. Res.
Gernert, Kim	BIMCORE, Emory	F	Caucasian	None	U.S.
Goodisman, Michael	Biology, Ga. Tech.	M	Caucasian	None	U.S.
Goodman, Mark	Radiology, Emory	M	Caucasian	None	U.S.
Gouzoules, Harold	Psych, Emory	M	Caucasian	None	U.S.
Grober, Matthew	Biology, GSU	M	Caucasian	None	U.S.
Haftel, Valerie	Biology, Morehouse College	F	Hispanic	None	U.S.
Hamann, Stephan	Psych, Emory	M	Caucasian	None	U.S.
Hampton, Robert	Psych, Emory	M	Caucasian	None	U.S.
Harris, Ruth	Nutrition, UGA	F	Caucasian	None	U.S.
Haynes, J.K.	Math and Science, Morehouse College	M	African Amer	None	U.S.
Heim, Christine	Psychiatry, Emory	F	Caucasian	None	Perm. Res.
Hu, Xiaoping	Biomed. Eng, Emory	M	Asian Amer	None	U.S.
Huhman, Kim	Psych, GSU	F	Caucasian	None	U.S.
Hummer, Daniel	Psych, Morehouse College	M	Caucasian	None	U.S.
Jackson, Duane	Psych, Morehouse College	M	African Amer	None	U.S.
Katz, Paul	Biology, GSU	M	Caucasian	None	U.S.
Keilholz, Shella	Biomed. Eng, Emory	F	Caucasian	None	U.S.
King, Tricia	Psych, GSU	F	Caucasian	None	U.S.
Kubanek, Julia	Biology, Ga. Tech.	F	Caucasian	None	U.S.
Kuhar, Michael	Yerkes, Emory	M	Caucasian	None	U.S.
Levey, Allan	Neurology, Emory	M	Caucasian	None	U.S.
Liu, Robert	Biology, Emory	M	Asian Amer	None	U.S.

Lu, Hang	Neuroengineering, Ga. Tech	F	Asian Amer	None	U.S.
MacLeish, Peter	Neuroscience, MSM	M	African Amer	None	U.S.
Maney, Donna	Psych, Emory	F	Caucasian	None	U.S.
Mayberg, Helen	Psychiatry, Emory	F	Caucasian	None	U.S.
McClure, Erin	Psych, GSU	F	Caucasian	None	U.S.
McCormack, Kai	Psych, Spelman	F	Caucasian	None	U.S.
McGinnis, Michael	Biology, Spelman	M	Caucasian	None	U.S.
Miller, Andrew	Psychiatry, Emory	M	Caucasian	None	U.S.
Moore, Tim	Psych, Clark-Atlanta	M	African Amer	None	U.S.
Muly, Christopher	Yerkes, Emory	M	Caucasian	None	U.S.
Murphy, Anne	Biology, GSU	F	Caucasian	None	U.S.
Mustari, Michael	Yerkes, Emory	M	Caucasian	None	U.S.
Neigh, Gretchen	Psychiatry, Emory	F	Caucasian	None	U.S.
Norrholm, Seth	Yerkes, Emory	M	Caucasian	None	U.S.
Okere, Chuma	Biology, Clark-Atlanta Univ.	M	African Amer	None	U.S.
Owren, Michael	Psych, GSU	M	Caucasian	None	U.S.
Pai, Aditi	Psych, Spelman College	F	African Amer	None	U.S.
Pallas, Sarah	Biology, GSU	F	Caucasian	None	U.S.
Parent, Marise	Psych, GSU	F	Caucasian	None	Perm Res.
Parr, Lisa	Yerkes, Emory	F	Caucasian	None	U.S.
Paul, Ketema	Neuroscience, MSM	M	African Amer	None	U.S.
Peterson, Shani	Psychology, Spelman	F	African Amer	None	U.S.
Petrulis, Aras	Psych, GSU	M	Caucasian	None	U.S.
Plotsky, Paul	Psychiatry, Emory	M	Caucasian	None	U.S.
Potter, Steve	Biomed. Eng, Ga. Tech.	M	Caucasian	None	U.S.
Preuss, Todd	Pathology, Emory	M	Caucasian	None	U.S.
Rainnie, Don	Psychiatry, Emory	M	Caucasian	None	U.S.
Ressler, Kerry	Psychiatry, Emory	M	Caucasian	None	U.S.
Rilling, Jim	Anthropology, Emory	M	Caucasian	None	U.S.
Robins, Diana	Psych, GSU	F	Caucasian	None	U.S.
Rordon, Chris	Imaging Center, GaTech	M	Caucasian	None	U.S.
Rothbaum, Barbara	Psychiatry, Emory	M	Caucasian	None	U.S.
Sanchez, Mar	Psychiatry, Emory	F	Caucasian	None	Perm. Res.
Sanyal, Subhabrata	Cell Biol, Emory	M	Asian	None	Perm Res.
Sathian, Krish	Neurology, Emory	M	Asian Amer	None	U.S.
Schumacher, Eric	Psych, Ga. Tech.	M	Caucasian	None	U.S.
Scott, John	Cell Biol, Emory	M	Caucasian	None	U.S.
Shilnikov, Andrey	Neuroscience Inst., GSU	M	Caucasian	None	Perm. Res.
Snyder, Rebecca	Zoo Atlanta	F	Caucasian	None	U.S.
Stoinski, Tara	Zoo Atlanta	F	Caucasian	None	U.S.
Thomas, James	Human Genetics, Emory	M	Caucasian	None	U.S.

Thompson, Karen	Biology, Agnes Scott College	F	Caucasian	None	U.S.
Tosini, Gianluca	Neuroscience, MSM	M	Caucasian	None	U.S.
Waldman, Irwin	Psychology, Emory	M	Caucasian	None	U.S.
Wallen, Kim	Psych, Emory	M	Caucasian	None	U.S.
Walthall, William	Biology, GSU	M	Caucasian	None	U.S.
Washburn, David	Psychology, GSU	M	Caucasian	None	U.S.
Weber-Levine, Margaret	Psych, Morehouse College	F	Caucasian	None	U.S.
Weinshenker, David	Human Genetics, Emory	M	Caucasian	None	U.S.
Wheaton, Lewis	Physiology, Ga, Tech.	M	African Amer	None	U.S.
Whitten, Patricia	Anthropology, Emory	F	Caucasian	None	U.S.
Wilczynski, Walt	Psych, GSU	M	Caucasian	None	U.S.
Wilson, Mark	Psychobiol, Emory	M	Caucasian	None	U.S.
Yang, Jenny	Chemistry, GSU	F	Asian	None	Perm. Res.
Zola, Stuart	Yerkes, Emory	M	Caucasian	None	U.S.

9.5.2. POSTDOCS

Name	**Dept. and Institution**	**Gender**	**Ethnicity/Race**	**Disability**	**Citizenship**
Black, Michael	Psych, GSU	M	Caucasian	None	U.S.
Charlton, Ben	Zoo Atlanta	M	Caucasian	None	Non-citizen
Choi, Dennis	Psychiatry, Emory	M	Asian Amer	None	U.S.
Ditzen, Beate	Psychiatry, Emory	F	Caucasian	None	Non-citizen
Gafford, Georgette	Psychiatry, Emory	F	African Amer	None	U.S.
Goursaud, Anne-Pierre	Psych, Emory	F	Caucasian	None	Non-citizen
Gutman, David	Psychiatry, Emory	M	Caucasian	None	U.S.
Heldt, Scott	Psychiatry, Emory	M	Caucasian	None	U.S.
Jasnow, Aaron	Psychiatry, Emory	M	Caucasian	None	U.S.
Johnson, Zach	Psychiatry, Emory	M	Caucasion	None	U.S.
Kamio, Michiya	Biology, GSU	M	Asian	None	Non-citizen
Lewis, Christine	Psychology, GSU	F	Caucasian	None	U.S.
Lutterschmidt, Deborah	Psychology, GSU	F	Caucasian	None	U.S.
Markham, Chris	Psych, GSU	M	Native Amer	None	U.S.
McGraw, Lisa	Psychiatry, Emory	F	Caucasian	None	U.S.
Miranda, Jason	Biology, Emory	M	Caucasian	None	U.S.
Nguyen, Mary	Biology, GSU	F	Asian Amer	None	U.S.
Pulliam, John	Neuroscience, MSM	M	African Amer	None	U.S.
Rozga, Agata	Psychology, GSU	F	Hispanic	None	U.S.
Smith, Aaron	Psychiatry, Emory	M	Caucasian	None	U.S.
Song, Kay	Psych, GSU	F	Asian	None	U.S.
Teubner, Brett	Biology, GSU	M	Caucasian	None	U.S.

Vaughan, Cheryl	Biology, GSU	F	African Amer	None	U.S.
Vrailis, Alysia	Cell Biol, Emory	F	Caucasian	None	U.S.

9.5.3. GRADUATE STUDENTS

Name	Dept. and Institution	Gender	Ethnicity/Race	Disability	Citizenship
Ahern, Todd	Psychology, GSU	M	Caucasian	None	U.S.
Almli, Lynn	Psychology, GSU	F	Caucasian	None	U.S.
Amoss, Toby	Neuroscience, Emory	M	Caucasian	None	U.S.
Badura, Marc	Psych, GSU	M	Caucasian	None	U.S.
Barrett, Natasha	Psych, GSU	F	Caucasian	None	U.S.
Basile, Ben	Psych, Emory	M	Caucasian	None	U.S.
Bauzo, Rayna	Neuroscience, Emory	F	Hispanic	None	U.S.
Been, Laura	Psychology, GSU	F	Caucasian	None	U.S.
Bruggeman, Emily	Psychology, GSU	F	Caucasian	None	U.S.
Chaney, Melissa	Psych, GSU	F	Caucasian	None	U.S.
Colunga, Vincent	Biology, GSU	M	Hispanic	None	U.S.
Creighton, Anna	Psych, GSU	F	Caucasian	None	U.S.
Doherty, James	Biology, GSU	M	Caucasian	None	U.S.
Donaldson, Zoe	Neuroscience, Emory	F	Caucasian	None	U.S.
Dunham, Leslie	Psychology, GSU	F	Caucasian	None	U.S.
Glavis-Bloom, Courtney	Psych, Emory	F	Caucasian	None	U.S.
Glover, Ebony	Psych, Emory	F	African Amer	None	U.S.
Gutzler, Stephanie	Biology, GSU	F	Caucasian	None	U.S.
Guzman, Dora	Psych, GSU	F	Hispanic	None	U.S.
Hanberry, Richard	Biology, GSU	M	Caucasian	None	U.S.
Hassett, Janice	Psych, Emory	F	Caucasian	None	U.S.
Hecht, Erin	Neuroscience, Emory	F	Caucasian	None	U.S.
Heimbauer, Lisa	Psychology, GSU	F	Caucasian	None	U.S.
Jutras, Michael	Neuroscience, Emory	M	Caucasian	None	U.S.
LaPrairie, Jamie	Biology, GSU	F	Caucasian	None	U.S.
LaRocca, Stephen	Psychology, GSU	M	Caucasian	None	U.S.
Leung, Cary	Psych, Emory	F	Asian Amer	None	U.S.
Lillvis, Joshua	Biology, GSU	M	Caucasian	None	U.S.
Lorenzi, Varenka	Biology, GSU	F	Caucasian	None	Non-citizen
Luckett, Cloe	Psychology, GSU	F	Caucasian	None	U.S.
Madsen, Teresa	Neuroscience, Emory	F	Caucasian	None	U.S.
Maguschak, Kim	Neuroscience, Emory	F	Caucasian	None	U.S.
Main, Keith	Psych, Ga. Tech.	M	Caucasian	None	U.S.
Maras, Pam	Psych, GSU	F	Caucasian	None	U.S.
Martinez, Luis	Psych, GSU	M	Hispanic	None	U.S.
Mascaro, Jenny	Anthropology, Emory	F	Caucasian	None	U.S.
Matragrano, Lisa	Psych, Emory	F	Caucasian	None	U.S.
McGee, Jennifer	Psychology, Emory	F	Caucasian	None	U.S.

Michopoulos, Vasiliki	Neuroscience, Emory	F	Caucasian	None	Perm. Res.
Miles, Leigh	Neuroscience, Emory	F	African Amer	None	U.S.
Modi, Meera	Neuroscience, Emory	F	Asian Amer	None	U.S.
Normandin, Joe	Biology, GSU	M	Caucasian	None	U.S.
Ogawa, Yoko	Psychology, GSU	F	Asian	None	U.S.
Paxton, Regina	Psych, Emory	F	Caucasian	None	U.S.
Payne, Christa	Psych, Emory	F	Caucasian	None	U.S.
Perdue, Bonnie	Psych, Ga. Tech.	F	Caucasian	None	U.S.
Randall, Eric	Biology, GSU	M	Caucasian	None	U.S.
Raper, Jessica	Psych, Emory	F	Caucasian	None	U.S.
Rolston, John	Biomed. Eng., Ga. Tech.	M	Caucasian	None	U.S.
Ross, Heather	Neuroscience, Emory	F	Caucasian	None	U.S.
Ross, Amy	Psych, GSU	F	Caucasian	None	U.S.
Ryan, John	Psych, GSU	M	Caucasian	None	U.S.
Sanford, Sara	Psychology, Emory	F	Caucasian	None	U.S.
Schwarb, Hillary	Psych, Ga. Tech.	F	Caucasian	None	U.S.
Shahbazi, Mahin	Biology, GSU	F	Caucasian	None	U.S.
Stephard, Katy	Biology, Emory	F	Caucasian	None	U.S.
Stephens, Shannon	Psych, Emory	F	Caucasian	None	U.S.
Tadesse, Tizeta	Biology, GSU	F	Asian Amer	None	U.S.
Victoria, Nicole	Biology, GSU	F	Caucasian	None	U.S.
Vytal, Katye	Psych, Emory	F	Caucasian	None	U.S.
Watts, Kelly	Neuroscience, Emory	F	Caucasian	None	U.S.
Wilson, Jennifer	Psychology, Emory	F	Caucasian	None	U.S.
Zeamer, Alyson	Psychology, Emory	F	Caucasian	None	U.S.

9.6. Summary listing of all of the Center's research, education, knowledge transfer and other institutional <u>partners</u> (the total number of non-academic organizations, including industry, states and other Federal agencies which work or share resources with the Center).

Organization	**Type**	**Location**	**Contact**	**Type of Partner**	**160+ hours (Y/N)**
Zoo Atlanta	Zoo	Atlanta, GA	Denis Kelley, CEO	K.T. and education	N
Atlanta Chapter of the Society for Neuroscience	Non-profit	Atlanta, GA	Pete Wenner, Pres.	Education and Research	N
GaBio	Non-profit	Atlanta, GA	Charles Craig, Pres.	K.T. and education	N
Keck Center for Beh. Biology, N.C. State	University	Raleigh, NC	Robert Anholt, Director	Education	N

CISAB, Univ. of Indiana	University	Bloomington, Ill	Gregory Demas, Director	Education	N

9.7. For internal NSF reporting purposes, provide a <u>Summary Table</u> with the following information:

The number of participating institutions (all academic institutions that participate in activities at the Center)	7
The number of institutional partners (total number of non-academic participants, including industry, states, and other federal agencies, at the Center)	0
The total leveraged support (sum of funding for the Center from all sources *other* than NSF)	$114,582,000
The number of participants	182 (+38 undergrads)

9.8. Describe any <u>media publicity</u> the Center received in the reporting period. Provide in an <u>Appendix</u> with any appropriate media materials that can be used to disseminate information on Center accomplishments and activities to the public.

<u>Press and Media Releases</u>

11/07/2008
Long-Term Benefits of Morphine Treatment in Infants Confirmed by GSU Study
CBN Member: Anne Murphy
Medical News Today (http://www.medicalnewstoday.com/articles/128025.php)
Other references: sciencedaily.com, anesthesiazone.com, thaindian.com, esciencenews.com, news-medical.net, asterpix.com, medworm.com, physorg.com, medicalnewstoday.com, bio-medicine.org, medindia.net, firstscience.com, dailyindia.com, and 101longtermcare.com

12/18/2008
Humans and Chimps Register Faces By Using Similar Brain Regions
CBN Member: Lisa Parr
ScienceDaily.com (http://www.sciencedaily.com/releasese/2008/12/081218122150.htm)
Other references: neurosciencenews.com, esciencenews.com, and thiaindian.com,

12/30/2008
Study First to Pinpoint Why Analgesic Drugs May Be Less Potent in Females Than in Males
CBN Member: Anne Murphy
Medical News Today (http://www.medicalnewstoday.com/articles/134123.php)
Other references: esciencenews.com, bio-medicine.org, physorg.com, biospace.com, highbeamresearch.com

Fall 2008

Lending Library a Popular Source in Summer
General CBN
The DANA Foundation website (http://www.dana.org/news/features/detail.aspx?id=13726)

March 2009
Loves Hurts
CBN Member Larry Young
Women's Health Magazine (paragraph on Breakthroughs p. 30)

3/18/2009
Georgia State/Georgia Tech Center for Advanced Brain Imaging to Expand Brain, Mind Research
General CBN
FirstScience News
Other references: Georgia State University website, The FINANCIAL (finchannel.com), bio-medicine.org, medicexchange.com

April 29, 2009
Brains Rule! Expo Helps Ignite Middle Schoolers' Neuroscience Curiosity
CBN Education Program
Georgia State University website (http://www2.gsu.edu/~wwwexa/news/archive/2009/09_0429-brains.html)

5/8/09
Why do people cheat?
Larry Young
Dateline NBC (aired May 8, 2009)

May 21, 2009
Georgia State Helps to Showcase Biotechnology in the Peach State
General CBN
Georgia State University website (http://www2.gsu.edu/~wwwexa/news/archive/2009/09_0521-biotech.html)

6/10/09
How Young Mice Phone Home: Study Gives Clue to How Mothers' Brains Screen for Baby Calls
CBN Member: Robert Liu
ScienceDaily (http://www.sciencedaily.com/releases/2009/06/090610124422.htm)
Other sources: vetscite.org, esciencenews.com, and physorg.com

6/24/09
Unlocking the Mind's Mysteries: Georgia State Neuroscientists Work to Expand the Understanding of the Brain
General CBN
Georgia State University Magazine and online (http://www.cas.gsu.edu/storydetail.aspx?id=337)

June 12, 2009
At the Zoo, Teachers Learn Ways to Improve Education
CBN Member: Laura Carruth
Georgia State University website (http://www2.gsu.edu/~wwwexa/news/archive/2009/09_0611-CBNworkshop.html)

July 16, 2009
Researchers Find That Eating High Levels of Fructose Impairs Memory in Rats
CBN Member: Marise Parent
Georgia State University Website (http://www2.gsu.edu/~wwwexa/news/archive/2009/09_0716-fructose.html)
Other references: biologynews.net, nutritionhorizon.com, esciencenews.com, sciencedaily.com, bio-medicine.org, medicalnewstoday, Newsmax.com, dietwords.com, energypublisher.com, thecuttingedgenews.com, *Scientific American Mind* print publication.

08/2009
Brain Explorers
CBN Education Program
Georgia State University website (http://www.gsu.edu/36473.html)

9/16/2009
Researchers Explore Long-Term Adolescent Vulnerability to Drugs
CBN Member: Kyle Frantz
Science Daily website (www.sciencedaily.com/releases/2009/09/090916173326.htm)
Other references: physorg.com, esciencenews.com, medicalnewstoday.com, newsguide.us, genengnews.com, latimes.com, and newsweek.com

9/23/2009
GSU Researchers Explore How Pain in Infancy Can Change Pain Sensitivity in Adulthood
CBN Member: Anne Murphy
Georgia State University website (http://www.gsu.edu/38361.html)

10/27/2009
Georgia State to Offer Master's and Doctorate Degrees in Neuroscience
General CBN
Georgia State University website (http://www.gsu.edu/39133.html)

X. INDIRECT/OTHER IMPACTS

10.1. Venture Grants awarded during reporting period to Center members

Fall 2008:
PIs: Brad Cooke, Elliott Albers, Kim Huhman, Aras Petrulis
The role of play fighting in the development of sex differences

PIs: David Gutman, Shella Keilholz
Voxel based morphometry and fiber tracking in small animals using high field MRI

PIs: Deborah Lutterschmidt, Dan Hummer
Molecular mechanisms mediating social modulation of circadian rhythmicity

PIs: Lisa Parr, Larry Young
The effect of oxytocin on social cognition in nonhuman primates

PIs: Shana Peterson, Kai McCormack
Physiological Responsiveness to Sexual Stereotypes in Music Videos and its Association with Sexual Attitudes and Behaviors

10.2. CBN events in 2008 - 2009

February 3rd – Georgia Regional Brain Bee Competition
Georgia State University

February 28th – 2009 Vole Conference
Over 100 investigators from across the globe came together to dicuss voles as an animal model for studying behavior, Decatur, Georgia

March 26 – 27th – CBN External Advisory Board Meeting

April 24th – Neuroscience Exposition at Zoo Atlanta
Reverse science fair for 170+ middle school students

May 23rd – CBN Spring Symposium: Social Cognitive Neuroscience: Studies in Human and Non-Human Primates
Invited speakers included:

Mike Platt, Ph.D., Duke University
Katalin Gothard, Ph.D., University of Arizona
Kevin Pelphrey, Ph.D., Yale University
James Blair, Ph.D., National Institutes of Health

May 23 – July 31st – BRAIN Summer Research Program
Undergraduate students

June 8 – July 31st – Institute on Neuroscience
High school students

June 8-12th – Why They Do What They Do at the Zoo: Animal Behavior and the Brain
Middle and high school teacher professional training workshop

July 20 – 24th – Brain Camp
Middle school students

September 26th – CBN Graduate Student/Postdoc Retreat
Poster presentations, talks, and group activities by CBN graduate students and postdocs, Alpharetta, Georgia

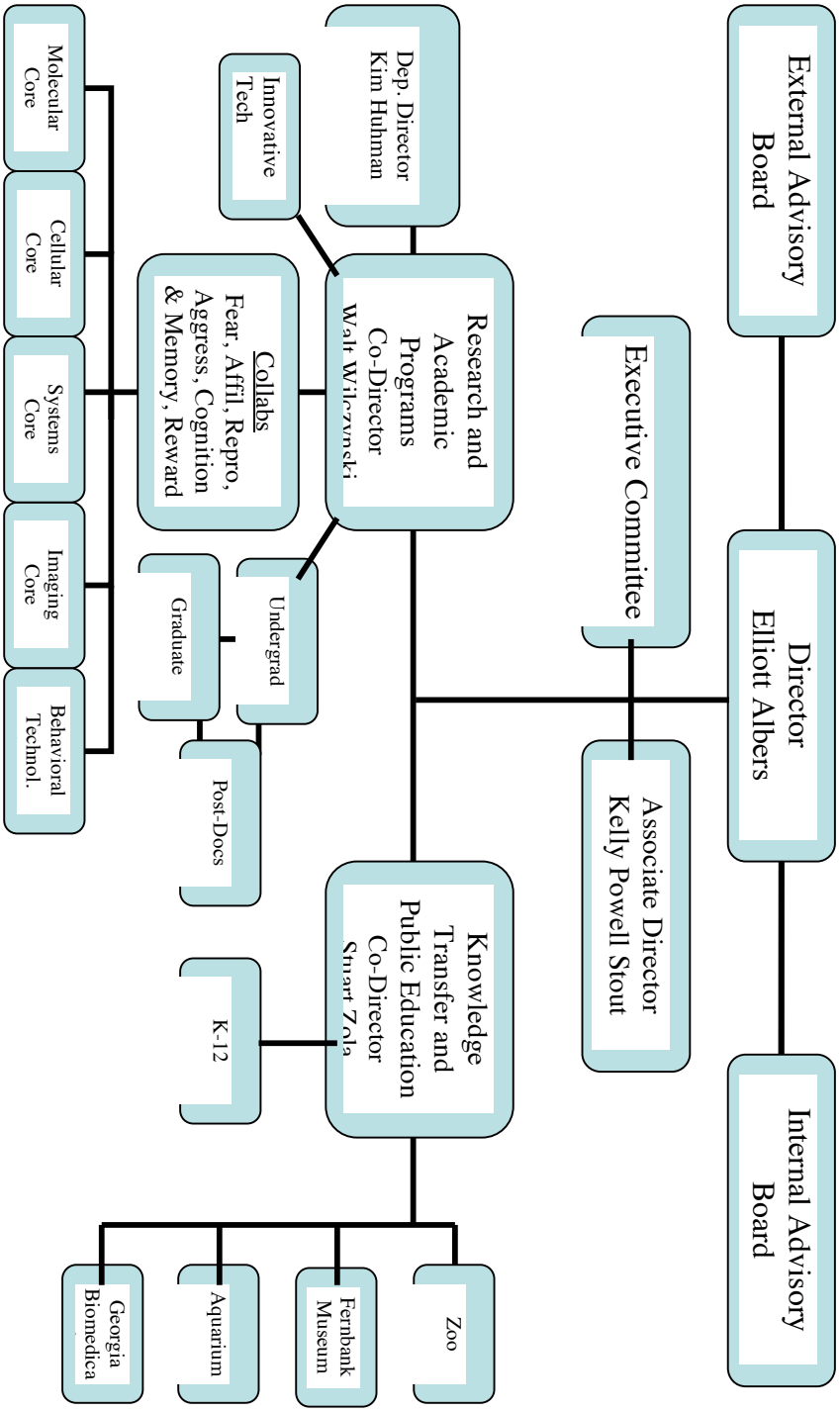
XI. BUDGET

11.1. No-cost extension through April 30, 2010
11.2. Support from All Sources.

	Current Award Year 9		Requested Award Year 10	
Award Source	Cash ($)	In-kind	Cash ($)	In-kind
NSF-STC	3,145,694		2,506,842	
Other Federal Agencies – DOE Earmark			80,567	
State Government				
Local Government				
DANA Foundation			20,000	
University - GSU	1,314,747		1,314,735	
Brain Camp Attendee Fees	2,000		2,000	
CBN Foundation - GSU	5,000		5,000	
GA Research Alliance			1,050,000	
TOTAL	4,467,441		4,979,144	

XII. APPENDICES

Appendix A: Management Structure



Appendix B: Minutes of Advisory Committee Meetings

Report of the CBN External Advisory Board (EAB): March 27, 2009

The CBN leadership summarized the center's accomplishments in the mission areas of research (establishment of collaboratories, faculty recruitment, publications, new grant funding), education (graduate and postdoctoral training, high school and undergraduate programs as well as teacher training) and knowledge transfer (partnerships with Zoo Atlanta, Fernbank Museum, GeorgiaBio) since NSF funding began in 1999. The EAB agreed that great strides were made in all three mission areas. CBN's performance proves that it has developed effective mechanisms for substantially improving inter-institutional collaboration, training and education in Atlanta. It is particularly notable that new collaboratories have developed in areas not proposed in the original application. The CBN's model for collaboration and development of new cross-institutional and cross-disciplinary research efforts—particularly the Center's collaboratories and venture grants—has proved itself over the years, and it continues to be an effective model for incubating new research initiatives and for forging productive ties among existing and new faculty. The collaboratories also provide an unusually rich environment for the education and training of graduate and undergraduate students and postdoctoral researchers. The EAB expects that these structures will yield benefits in both research and education in the future if they continue to be supported.

The remainder of the meeting was devoted to a summary and discussion of past and ongoing efforts to identify and obtain funding for CBN research, education and knowledge transfer programs. CBN leaders have focused primarily on identifying and pursuing new sources of support for CBN programs over the past year. There has been significant progress in each of these domains, and the EAB offered a number of suggestions to help move these initiatives forward. The major efforts are summarized below for each CBN mission area.

Research

- CBN partner institutions, with the exception of Georgia State University (GSU), have not committed any financial support for the continuation of the CBN. GSU has committed to providing support in the form of staff salaries for the continued organization and administration of the CBN programs.
- No sources of funding have been identified to continue the highly successful venture grant program.
- The CBN received a $100,000 planning grant from the Templeton Foundation for the establishment of a new research collaboratory on "positive emotions." This grant provides funding to bring together groups of investigators to develop project proposals related to this under-addressed field. The Templeton Foundation will review and award money to individual project(s). It is anticipated that the CBN can continue to submit new project proposals for review and funding as long as the Templeton Foundation maintains its interests in CBN programs. Therefore, this may be a source of long-term funding.
- The CBN leadership had direct discussions with the Keck Foundation and was encouraged to submit group project proposals focused on the neurogenetics of social behavior. In response, the CBN recently submitted 4 multidisciplinary, multi-

institutional project proposals to the Keck Foundation via the GSU Development Office. Depending upon the success of these projects, there is the potential for additional funding for other projects as long as the Keck Foundation maintains its interests in CBN programs.

- CBN members from GSU and Emory University are part of an NIH U54 cooperative center grant proposal on genetics and genomics of social behavior. This could provide some support for both research and student training. If funded, this would formally expand the CBN's ties to institutions outside the Atlanta area.
- GSU's new Neuroscience Institute, which developed directly from the CBN's efforts at this institution, is spearheading a new initiative in neurotherapeutics. GSU will lead this effort to pull together investigators from several of the CBN's partner institutions (GSU, Georgia Tech, Emory, Morehouse School of Medicine) to develop large research project proposals and to seek support for this multi-institutional effort from the Georgia Research Alliance, a major supporter of the CBN over the past 10 years.

Education

- Many funding agencies support new programs but restrict funding for programs that are already established and successful. This has proven to be a difficult hurdle for the CBN to clear. CBN's education program directors are looking at many potential sources of funding, some very creative, to keep these successful programs going beyond the NSF-STC funding period. It is clear to the EAB that the Center's education programs have matured significantly over the years and now represent important assets in K-12 education in the Atlanta area and in pre-college neuroscience education more generally. The quality and scope of the CBN's education programs demonstrate the value of CBN's support of faculty who are both research scientists and science educators (e.g., Laura Carruth & Kyle Frantz) and the commitment of many Center members to participation in education and outreach programs.
- Funding for the postdoctoral and graduate training programs has been the most difficult to identify. Efforts to obtain an IGERT grant were unsuccessful as these were not considered "innovative" programs by the reviewers.
- CBN science educators have obtained funding from NIGMS for the CBN's summer undergraduate research program by adding a new component to the existing program. The funding, however, covers only the "new" part of the program and hence provides only half of the program's financial needs. The program director will seek funding for the other part of the program from a number of sources including REESE, REU, US-DOE minority grant, NIDA Partner Education grant, stimulus supplements, etc.
- Funding for the CBN's K-12 programs is based on year-to-year fund-raising efforts. The Dana Alliance continues to be a major supporter of the 3 main programs: ION for high school, Brain Camps for middle school, and K-12 Teacher Workshops. Dana support seems likely to continue, but only covers a small portion of these programs' expenses. Grants from other sources currently in the planning phase include an NIH SEPA grant to combine the Brain Camps and Teacher Workshops, an NSF STEM grant for the Teacher Workshops, and an international training grant for ION students. There is also potential for congressionally directed funding for Teacher Workshops.

Knowledge transfer

- Some of the smaller educational and knowledge transfer programs and initiatives were been handed over to the Atlanta Chapter of the Society for Neuroscience, the new primary sponsor. Thus, these programs should continue indefinitely. These include the K-12 classroom visits for Brain Awareness Month, the Georgia Regional Brain Bee competition for high school students, the Neuroscience in the Movies events, and the management and upkeep of the CBN's Lending Library of teaching and learning resources.
- There was no discussion about future funding of the CBN's public Neuroscience Exposition. It is unlikely that this program will be funded beyond 2009.

Appendix C. Presentations (N = 460) and Publications (N = 454)

Presentations (N=460)

Adams, Kenyeda, Jonell Belle, A. Pai. Effect of male genotype on female lifespan in three populations of beetles in absence of insecticide pressure. Poster Presentation, South East Ecology and Evolution conference, Gainesville, Florida, 2009.

Adams, K., J. Belle, A. Pai. Effect of male genotype on female lifespan in three populations of beetles. Poster Presentation, HBCU-UP conference, Washington DC, 2009.

Adelore, T. A., Schwarb, H., & Schumacher, E. H. (2009). Effective connectivity evidence for a relationship between spatial response selection and spatial sequence learning. Poster presented at the annual meeting of the Cognitive Neuroscience Society, San Francisco, CA.

Ahern TH, Young LJ. (Poster) Early life family structure influences emotionality, spontaneous parental behavior, and neuropeptide receptors in adult prairie vole. Vole Meeting, Atlanta, GA, February, 2009

Ahern TH, Young LJ. (Poster) Early life family structure influences emotionality, spontaneous parental behavior, and neuropeptide receptors in adult prairie vole. Society for Neuroscience, Washington, DC, November, 2008

*Ahern TH, Young LJ. (Poster) Early life family structure influences primiparous parenting behavior and hypothalamic oxytocin content. Society for Neuroscience, Chicago, IL, October, 2009.

*Ahern TH, Young LJ. (Talk) Evaluation of two automated systems for analyzing partner preference tests. Vole Meeting, Atlanta, GA, February, 2009

*Ainsworth, K., Grand, A., Sawyer, N., Sanchez, M.M., McCormack, K. (2009). Maternal maltreatment, serotonin, cortisol, and aggression in rhesus macaques: How are they connected. Poster presented at the Annual Meeting of the Southeastern Psychological Association, New Orleans, LA, 2009.

*Amoss, R. T., & Owren, M. J. (2009, Oct). Frontal alpha and beta EEG power asymmetry and Iowa Gambling Task Performance. Society for Psychophysiological Research, Berlin, Germany.

Anderson, S., Khowaja, M., Robins, D.L., & Adamson, L.B. (May 2009). Adding ESCS measures of initiating and responding to joint attention to the M-CHAT. Poster presented at the International Meeting for Autism Research, Chicago, IL.

Anderson, S.A., Robins, D.L., & Adamson, L.B. (2009, February). Differentiation of autism spectrum disorders from other developmental delays: M-CHAT plus a measure of initiation of

joint attention. Poster presented at the International Neuropsychological Society, Atlanta, GA.
Auyang, A.., and Y.-H. Chang. Effects of increased task difficulty on performance variable stabilization during human locomotion. Am. Soc. Biomech., State College, PA, 2009.
Baile, C.A., Bartell, S., Gaddam, D.R., Ambati, S., Rayalam, S., Hartzell, D.L., Hamrick, M., She, J.-X., Kuhar, M. and Della-Fera, M. Central leptin treatment mediation of bone marrow cell differentiation is enhanced when caloric restriction is imposed upon male mice. Society for Neuroscience, Washington D.C., 2008.
*Banks, M.S., Robins, D.L., King, T.Z., & Henrich, C.C. (2009, May). Investigating the role of emotion perception in the communication skills of individuals on the autism spectrum. Poster presented at the International Meeting for Autism Research, Chicago, IL.
*Barks SK; Parr, LA; Hecht, E; Votaw, JR; Rilling, JK. Comparing social cognitive, non-social cognitive, and resting brain activity in chimpanzees. Association of Physical Anthropologists, Chicago, Illinois, March 31, - April 4, 2009.*Barrett, P., Van den Top, M., Song, C. K., Bartness T. J., Morgan, P. and Spanswick, D. DmpARC neurons are activated by short day photoperiod in the brain of Siberian hamsters. European Biological Rhythms Society, Strasbourg, France, 2009.
*Barrett, P., Van den Top, M., Song, C. K., Bartness T. J., Morgan, P. and Spanswick, D. DmpARC neurons are activated by short day photoperiod in the brain of Siberian hamsters. British Society of Neuroscience, Edinburgh, Scotland, 2009.
*Basile, B.M. & Hampton, R.R. Comparison of visual recall and visual recognition tests in rhesus monkeys (Macaca mulatta). Society for Neuroscience, Chicago, IL, October 17-21, 2009.
*Basile, B.M. & Hampton, R. R. Performance of rhesus monkeys (Macaca mulatta) in tests of recall and recognition parallels human memory. The Primate Mind, Erice, Sicily, ITALY. June 4-7, 2009
*Basile, B.M., Ortiz, M. R., & Hampton, R. R. Effects of image set size and practice on the serial position curve in rhesus monkeys (Macaca mulatta). International Conference on Comparative Cognition, Melbourne Beach, FL. March 18-21, 2009.
Bauman, J., and Y.-H. Chang. Conservation of limb function after peripheral nerve injury in rat locomotion. American Society of Biomechanics, State College, PA, 2009.
Bauman, J., and Y.-H. Chang. Rodent skin movement error correction by high-speed x-ray kinematics for locomotion studies. Society for Neuroscience, Washington, DC, 2008.
*Been, L. and Petrulis, A. “Lesions of the posterior bed nucleus of the stria terminalis eliminate opposite-sex odor preference in sexually-naïve, but not sexually experienced, male Syrian hamsters.” Society for Behavioral Neuroendocrinology, East Lansing, MI, June 2009.
*Been, L. and Petrulis, A. “The role of the medial preoptic area in opposite-sex odor preference in male Syrian hamsters.” Society for Neuroscience, Chicago, IL, November, 2009.
*Been, L.E. & Petrulis, A. (2008) The role of the posterior bed nucleus of the stria terminalis in opposite-sex odor preference and social odor processing in male Syrian hamsters. Society for Neuroscience, Washington, D.C.
*Bhargav K. Errangi, Longchuan Li, Matthew F. Glasser, Xiaodong Zhang, Helen.S.Mayberg, Xiaoping Hu, Todd M. Preuss and James K. Rilling.Brain white matter asymmetries in humans and non-human primates - A comparative diffusion and structural Magnetic Resonance Imaging (MRI) study. Neuroscience Meeting, Chicago, IL, 2009.
*Binder, Elisabeth, Rebekah Bradley, Joseph F. Cubells, Todd C. Deveau, Christine M. Heim, Florian Holsboer, Elyse R. Katz, Andreas Menke, Charles b. Nemeroff, D. Jeffrey Newport, Kerry Ressler, Zachary N. Stowe. (2008) FKBP5, regulation of the stress hormone response and depressive disorder. American College of Neuropsychopharmacology; Phoenix, Arizona.

*Black, M.P., K.J. Ressler, R.L. Earley, and W. Wilczynski. Social Status and Brain Neurotrophins in Anolis carolinensis.Anolis Conference, Harvard University, October 2009.
Black, M.P., C.B. Ezeoke, S.J. Salem, M. J. Sabula, and W. Wilczynski. Anolis carolinensis male-male agonistic encounters: a three year study of the best predictors for determining dominant/subordinate status. Anolis Conference, Harvard University, October 2009.
*Black, M.P., C.B. Ezeoke, S.J. Salem, M.J. Sabula and W. Wilczynski (2009) Anolis carolinensis male- male agonistic encounters: a three year study of the best predictors for determining dominant/subordinate status. Annual Conference on Anolis research.
*Blanding N, Norrholm S, Duncan E, Ressler K, Jovanovic T. Physical and sexual child abuse has long- term effects on startle response magnitude. Presented at Annual Meeting, International Sociaty for Traumatic Stress Studies, Atlanta GA, 2009.
*Blanding NQ, Norrholm SD, Duncan E, Bradley B, Ressler KJ, Jovanovic T. Childhood abuse is associated with increased startle reactivity in adulthood. Presented at Annual Meeting, Anxiety Disorders Association of America, Albuquerque, NM, 2009.
Bright, Millicent, Erica Lampkin, KaTerri Kelly, Jonell Belle A. Pai. Effect of social environment on evolution of reproductive traits in the red flour beetle, Tribolium castaneum. Poster Presentation, South East Ecology and Evolution conference, Gainesville, Florida, 2009.
Brosnan, Sarah F. (August, 2009) The evolution of social preferences. Symposium on Evolutionary Perspectives on Social Cohesion and Decision Making. Presented at the American Psychological Association annual meeting, Toronto, Canada.
Brosnan, Sarah F. (October, 2009) Property in non-human primates. Symposium on Property. Presented at the Child Development Society annual meeting, San Antonio, TX.
Brosnan, Sarah F., Talbot, Catherine, Ahlgren, Megan, Lambeth, Susan P., and Schapiro, Stephen J (September, 2009) A sex difference in the response to inequity in chimpanzees. Presented at the American Society of Primatologists annual meeting, San Diego, CA.
Brosnan, Sarah. Inequity and prosocial preferences. The Evolution of Social Psychology, Yale University, New Haven, CT (2008, November).
Brosnan, Sarah. Property in non-human primates. Chapman University, Department of Economics, Orange County, CA (2009, November).
Brosnan, Sarah. Responses to inequity in nonhuman primates. Emory University, Department of Anthropology, Atlanta, GA (2008, October).
Brosnan, Sarah. Studying inequity in nonhuman primates. Baylor University, Department of Psychology & Neuroscience, Waco, TX (2009, October).
Brosnan, Sarah. The evolutionary underpinnings of the endowment effect. Florida State University School of Law, Tallahassee, FL (2008, September).
Bruggeman E., Darling, J. Bartness, T. J., and Parent, M. Fish Oil Attenuates the Memory-Impairing Effects of a High-Fructose Diet in Male Rats. Society for Neuroscience, Chicago, IL, 2009.
Buffalo, E.A. Neuronal Synchronization and Memory, Brain and Behavior Discovery Institute, Medical College of Georgia, April, 2009
Buffalo, E.A. Theta-band Oscillations in the Monkey Hippocampus, Spring Hippocampus Meeting, Verona, Italy, May, 2009.
Buffalo, E.A. Theta-band Oscillations in the Monkey Hippocampus, Winter Conference on the Neurobiology of Learning and Memory, Park City, Utah, January, 2009
Bui, H. , Normandin, J. and Murphy, A.Z. Projections from the Paraventricular Nucleus to the spinal cord; Role in male sexual behavior. Society for Neuroscience, Washington, D.C., 2008.

Burton, M., Price, M., Schmertz, S. K., & Anderson, P (2009, November). The relation between mindfulness and social anxiety symptoms over the course of treatment for social anxiety disorder. Poster to be presented at the 43nd annual meeting of the Association for the Advancement of Behavior and Cognitive Therapy. New York, NY, 2009.
Calamaras, M. R. & Anderson, P. (2008, November). Personality psychopathology as a predictor of pre-treatment symptom severity, treatment behavior, and treatment response in a sample of socially anxious adults. Poster presented at the 42nd annual meeting of the Association for the Advancement of Behavior and Cognitive Therapy. Orlando, FL, 2008.
Carruth, L.L. The Estrogen Receptor Alpha Coactivator, RPL7, and Sexual Differentiation of the Songbird Brain, Steroids and the Nervous System Conference, Turin, Italy, Feb. 16, 2009.
Carruth, L.L., Duncan, KA., Sexually dimorphic production of neurosteroids in developing zebra finches. Abstract for poster presentation to 38th Annual Society for Neuroscience meeting, Washington DC, November, 2008.
Chang, Y.-H. Satellite symposium of the Annual Conference of Amer. Academy of Orthotists & Prosthetists. Symposium on Prosthetics & Orthotics, Georgia Tech, Atlanta, GA, 2009
Chang, Y.-H. Seminar Series. Dept. of Kinesiology, Simon Fraser University, Burnaby, B.C., Canada, 2009
Chang, Y.-H. Spinal Cord Research Center Seminar Series. Dept. of Physiology, Emory University, Atlanta, GA, 2009
Chang, Y.-H. Symposium on Robotic Prostheses, Orthoses and Wearable Robotic Systems. IEEE Engineering in Medicine & Biology Conference, Minneapolis, MN, 2009
CHEN, Z., E. I. MARTIN, J. P. CHHATWAL, A. M. JASNOW, M. J. OWENS, D. G. RAINNIE, K. J. RESSLER. Generation of a novel transgenic mouse line expressing Cre recombinase driven by a corticotrophin-releasing factor (CRF) promoter. Society for Neuroscience meeting, Washington, D.C., 2008.
*Cheng, Q., M. Graves, S.L. Pallas (2009) Retinal EphA5 expression is altered by traumatic brain injury in the visual pathway. GA/SC Neuroscience Consortium, UGA, Athens, GA, 2009.
*Cheng, Q., M. Graves, S.L. Pallas (2009) Retinal EphA5 expression is altered during recovery from traumatic brain injury to the superior colliculus. Society for Neuroscience, Chicago, IL, 2009.
*Choi DC, Maguschak KA, Myers KM, Ressler KJ. Prelimbic cortical brain derived neurotrophic factor modulates consolidation of conditioned fear. Society for Neuroscience Annual Meeting, Chicago, IL, 2009.
*Choi DC, Maguschak KA, Myers KM, Ressler KJ. The role of cortical brain derived neurotrophic factor in modulating aversive and appetitive learning. 2009 Gordon Conference: Amygdala in Health and Disease: Contributions to Emotional Memories, Waterville, ME, 2009.
Choi DC, Myers KM, Maguschak KA, Ressler KJ. Cortical brain derived neurotrophic factor modulates expression of appetitive and aversive learning in mice. Society for Neuroscience Annual Meeting, Washington, DC, 2008.
Chung, Kwanghun, and Hang Lu, “Automated High-Throughput Cell Microsurgery on-Chip”, Society of Neuroscience Meeting, Chicago, IL, Oct 2009
Chung, Kwanghun, Jae Kyu Cho, Hang Lu and Victor Breedveld, "High resolution temperature measurement in microfluidic systems using the Brownian motion of colloids"; 13th International Conference and Surface and Colloid Science, New York, NY, June 14-19, 2009.
Chung, Kwanghun, Jaekyu Cho, Lauren Cheplen, Victor Breedveld, and Hang Lu, “Three-dimensional In Situ Temperature Measurement in Microfluidic System Using Brownian Motion

of Nanoparticles," the Proceedings of the Twelfth International Conference on Miniaturized Systems for Chemistry and Life Sciences (microTAS), Oct 2008, San Diego.
Chung, Kwanghun,Jaekyu Cho, Lauren Cheplen, Victor Breedveld, and Hang Lu, "Three-dimensional In Situ Temperature Measurement in Microfluidic System Using Brownian Motion of Nanoparticles," AIChE Annual Meeting, Nov 2008, Philadelphia.
Cobb, J.E., Jackson, L.C., Anderson, P. (2009, October). Teaching multicultural issues in psychology: A model for increasing both teacher and student cultural competence. Symposium presented at Society for Teaching of Psychology Best Practices Conference, Atlanta, GA, 2009.
Cooke, Bradley. Puberty in the medial amygdala, Presentation at the Center for Reproductive Science Annual Symposium, Northwestern University, Evanston, IL. October, 2009.
Copp, B.R., McCormack, K., Grand, A., Glasser, M., Li, W., Sawyer, N., Zhang, X., Graff, A., Maestripieri, D., Hu, X., & Sanchez, M. (2008). Alterations in white matter microstructure correlate with behavioral and physiological differences associated with infant maltreatment in rhesus monkeys (M. mulatta). Washington, D.C.: Society for Neuroscience, 2008.
*Cortes, Andres, Jackson, Duane M. Caliman, Alisha D. The search for the genetic basis of aggression in termites Reticulitermes sp. Annual Biomedical Research Conference for Minority Research Conference for Minority Students (ABRCMS), Orlando, Florida, November 2008.
Crane Matthew, Chung, Kwanghun, Lu, Hang. "Automated On-Chip Rapid Microscopy for C. elegans Systems Biology," Association of Laboratory Automation meeting, San Diego, January 2009.
Crane, Matthew M., and Hang Lu, "Machine learning for spatiotemporal analysis of transcriptional regulation through analysis of GFP expression", BMES Annual Meeting, Pittsburg, PA, 2009
*Creighton, A. E., Lutterschmidt, D. I., and Wilczynski, W. (2009) Effects of melatonin on tyrosine hydroxylase labeling in the green treefrog (Hyla cinerea). Society for Neuroscience, Chicago, Ill., 2009.
Cubells JF, Conneely K, Smith AK, Tang Y-L, Kilaruc V, Cuthbert B, Boshoven W, Hollis J, Corcoran S, Duncan E. Evaluation of cytosine methylation in blood-derived DNA from cocaine-dependent and non- dependent subjects. To be presented at Annual Meeting, American College of Neuropsychopharmacology, Hollywood, FL, 2009.
DABROWSKA, J., D. G. RAINNIE. Differential expression of signal transduction proteins and CRF-R2 receptors in CRF-containing neurons of the hypothalamus and extended amygdala. Society for Neuroscience meeting, Washington, D.C., 2008.
DABROWSKA, J.A., A. J. MCDONALD, F. MASCAGNI, J. F. MULLER, D. G. RAINNIE. Regional and subcellular distribution of the type 2 corticotrophin-releasing factor receptor (CRF2) in the bed nucleus of the stria terminalis (BNST) . Society for Neuroscience Presentation, Chicago IL, 2009.
*Demetrikopoulos, M.K., Pecore, J.L., Britner, S.L., Carruth, L.L., DeHaan, R.L., Falkenberg,K.L., Gagne,P.E., Goode,C.T, Williams,B.A., & Frantz K.J. (2009) Comparing Collaborative Research and Apprenticeship Models in Designing Undergraduate Summer Programs. Third Annual Conference on Understanding Interventions that Broaden Participation in Research Careers, Bethesda, MD, May 2009.
Derby, Charles. Escape by inking: marine molluscs avoid predators with diverse chemicals and mechanisms. University of Lund, Zoology Dept., Sweden, October 16, 2008.
Derby, Charles. Chemical communication in affiliation, aggression, and mating of decapod crustacean, Clayton State University, October 22, 2009.

Derby, Charles. Chemical communication in affiliation, aggression, and mating of decapod crustaceans. 5th Brasilian Crustacean Congress, Nov 11 2008, Gramado, Brasil.
Derby, Charles. Chemical signals in the aquatic environment, and how they are detected. lecture in International Course in Sensory Ecology, Lund, Sweden, October 13, 2008.
Derby, Charles. Escape by Inking: Marine Molluscs Avoid Predators Using Diverse Chemicals and Mechanisms, 2009 Edmund A. Arbas Memorial Lecture, Arizona Research Laboratories Division of Neurobiology, University of Arizona, January 23, 2009.
Derby, Charles. Mechanisms of chemical defense by inking molluscs against crustaceans: diverse chemicals and mechanisms. 5th Brasilian Crustacean Congress, Nov 12 2008, Gramado, Brasil.
Deshpande, G., K. Sathian & X. Hu. Compensating for zero-lag correlation effects in time-lagged Granger causality analysis. Organization for Human Brain Mapping, 2009.
Dhamala, M. Is the brain's inertia for movement different for acceleration and deceleration? Institute on Neuroscience Presentation, Yerkes National Primate Research Center, Atlanta, July 2009.
Dhamala, M. Time delays in Neural Systems. Spineless Neuroscience Forum, GSU/GT/Emory, Atlanta, April 10, 2009.
Dindo, M., T. Stoinski, F. Subiaul, and A. Whiten. Social Learning and Diffusion of Novel Foraging Tasks in Orangutans (Pongo pygmaeus, Pongo abelii). American Society of Primatologist meeting, 2009.
*Doherty, J.M., Frantz, K.J. (2009) Self-administration of heroin and incubation of heroin-seeking in adolescent vs. adult rats. Society for Neuroscience meeting, Chicago, Il, 2009.
*Doherty, James, Chen Li, Yvonne Ogbonmwan, Bonnie Williams and Kyle Frantz. Reinstatement of Drug-Seeking Behavior in Adolescent and Adult Male Rats. Winter Conference on Brain Research, Copper Mountian, CO, 2009.
*Doherty, James. Self-Administration of Heroin and Incubation of Drug-Seeking Behavior in Adolescent and Adult Male Rats. Symposium for Young Neuroscientists And Professors of the SouthEast (SYNAPSE) annual meeting, Student Travel Presentation, Charleston, SC, 2009.
Dulas, MR and Duarte, A. Effects of aging on domain general and domain specific source memory. Society for Neuroscience, Chicago, Ill., 2009
Duncan E, Hasenkamp W, Epstein MP, Green A, Wilcox L, Boshoven W, Lewison B. Heritability of acoustic startle, prepulse inhibition and onset latency in schizophrenia and control families. Presented at Biennial Meeting, International Congress on Schizophrenia Research, San Diego, CA, 2009.
Duncan EJ, Woolson SL, Hamer RM. Medication compliance in VA schizophrenia spectrum patients treated with risperidone consta. Presented at Annual Meeting, Institute on Psychiatric Services, New York, NY, 2009.
*Duncan, KA, C Dams, P Jimenez, and LL Carruth. 2009. Knock-down of selective estrogen receptor coactivator RPL7 protein expression alters neuron number and volume in zebra finch song nuclei. Poster 666.8. Society for Neuroscience, 2009, Chicago, IL. 2009
*Duncan, KA, CJ Saldanha, and LL Carruth. 2009. Sex differences and localization of steroid receptor coactivator 1 (SRC-1) in the adult zebra finch brain. Poster 666.7. Society for Neuroscience, 2009, Chicago, IL. 2009
Duncan, KA., Clancy, A.N., Carruth, L.L., Hormonal regulation of estrogen receptor coactivators in adult male zebra finches. Abstract for poster presentation to 38th Annual Society for Neuroscience meeting, Washington DC, November, 2008.

*Dunham, L. A., Lutterschmidt, D. I., and Wilczynski, W. (2009)Kisspeptin-Like Immunoreactive Neuron Distribution in the Green Anole (Anolis carolinensis). Society for Neuroscience, Chicago, Ill., 2009.
Edwards, S., Hudepohl, A., Price, M. & Anderson, P. (2008, November).Effects of Therapist Experience in a Manualized Treatment for Social Anxiety. Poster presented at the 42nd annual meeting of the Association for the Advancement of Behavior and Cognitive Therapy. Orlando, FL, 2008.
EHRLICH, D.E., S. RYAN, J. A. DABROWSKA, R. HAZRA, D. G. RAINNIE. Developmental transitions in inhibitory synaptic transmission in the basolateral amygdala. Society for Neuroscience Presentation, Chicago IL, 2009.
Eidson, L. and Murphy, A.Z. Persistent pain alters the induction of morphine tolerance and glial cell activation in the midbrain periaqueductal gray. Soc. Neurosci. Meeting, Chicago, Ill., 2009.
English, B.A., Hahn, M.K., Gizer, I.R., Steele, A., Waldman, I.D., & Blakely, R.D. Family-Based Association of a Functional Promoter Polymorphism in the Choline Transporter Gene with Attention- Deficit Hyperactivity Disorder. Society for Neuroscience in Washington, DC November 15 – 19, 2008.
Errangi BK, Li L, Glasser MF, Zhang Z, Mayberg HS, Hu X, Preuss TM, Rilling JK. 2009. Brain white matter asymmetries in humans and non-human primates – a comparative diffusion magnetic resonance imaging (MRI) study. Soc Neuroscience Meeting, Chicago, IL, 2009.
Fani, N., Bradley, B. G., Ressler, K., & Tone, E. B. (November, 2009). Attention bias and Posttraumatic Stress Disorder: A case for ecologically salient stimuli in information-processing research. In N. Fani (chair), Information Processing in PTSD: Cognitive Research Across Different Stages of Processing. 2009 Meeting of the ISTSS.
Fani, N., Ortigo, K., Elon, S., Johnson, E., Seely, P. W., Crowe, B., McClure-Tone, E. B., Ressler, K J., Bradley, R.G. (November, 2008). Intellectual Resources and Posttraumatic Stress Disorder in an Urban Primary Care Sample. Poster accepted for presentation at the 2008 ISTSS Annual Meeting.
Ferguson, B. & Anderson, P. (2008, November) Caucasian and "Other": A review of race in treatment outcome studies for social anxiety. Poster presented at the 42nd annual meeting of the Association for the Advancement of Behavior and Cognitive Therapy. Orlando, FL, 2008.
Fink, C., and Y.-H. Chang. Center of pressure movement during gait initiation in transtibial amputees. American Academy of Orthotists and Prosthetists, Atlanta, GA, 2009.
Fink, C., Yen, J., Auyang, A. and Y.-H. Chang. Body center of pressure control during gait initiation in transtibial amputees. Amer. Soc. of Biomechanics, State College, PA, 2009.
Foeller P, Bradley D, Tychsen L (2008). Birth-onset vs later-onset infantile strabismus in macaque monkeys: 3. Effects on smooth pursuit/OKN. Program No. 667.20. Society for Neuroscience, Washington, D.C., 2008.
*Frantz, K.J. (2009) "Adolescent (in)Vulnerability: Age Differences in Drug Intake and Relapse in Rats" Clayton State University, Jonesboro, GA, September 2009.
*Frantz, K.J. (2009) "Adolescent (in)Vulnerability" Georgia State University Brains & Behavior Seed Day, Atlanta, August 2009
*Frantz, K.J. (2009) "Collaborative Research for Novice Undergraduates" Invited presentation at Principal Investigators Meeting for NIGMS Efficacy Grant Awardees, San Francisco, CA, August 2009.
*Frantz, K.J. (2009) "Single-shot and in-depth neuroscience education programs: recruitment and retention." Invited presentation in symposium entitled "Translational Neuroscience: From

Bench to Classroom and Back" 2009 Abstract Viewer/Itinerary Planner. Society for Neuroscience, Chicago.
*Frantz, K.J., Lee, A., Doherty, J.M., Li, C., Williams, B., Ross, A., Bruggeman, E., Parent, M. (2009) A high fructose diet does not affect amphetamine self-administration in female rats. Society for Neuroscience meeting, Chicago, Il., 2009.
Fukuhara, C., Lee, S.K., Singhapakdi, K., Chen, C.S., Maddox, C., Iuvone, P.M. Differential gene expression analysis by acute and chronic lithium treatment in human primary fibroblasts. XVIIth World Congress on Psychiatric Genetics, San Diego, CA. Nov. 4-8 (2009).
*Gafford, G.M., Z. Chen, A. Jasnow, S. Heldt, E. Martin, M. Owens, W. Wisden, D. Rainnie, K. Ressler. Enhanced anxiety in transgenic mice with crf neuron-specific deletion of GABA receptors. 2009 Society for Neuroscience Presentation, Chicago IL, 2009.
Galindo-Leon, E.E., R. C. Liu, Network precision plasticity for communication calls in awake mouse auditory cortex, Tucker-Davis Symposium on Advances and Perspectives in Auditory Neurophysiology, Washington, DC, November 14, 2008.
Galindo-Leon, E.E., R. C. Liu, Wide-band LFP predicts cortical single unit firing probability better than θ-, β- or γ-band LFP, 38th Annual Meeting of the Society for Neuroscience, Washington, DC, November 15-19, 2008.
Gibson, G.O., C. D. Makinson, H. R. Dinse & K. Sathian. Tactile co-activation improves detection of afferent spatial modulation. Society for Neuroscience, Washington, D.C., October 2008.
Goulding, S. M., Esterberg, M., McClure-Tone, E. B., Compton, M. T. (March, 2009). Schizotypy: Psychometric properties and factorial structure of three self-report rating scales, demographic correlates, and associations with nicotine, alcohol, and cannabis use. A poster presented at the 2009 International Congress on Schizophrenia Research, San Diego, California.
Goursaud A.-P.S., Bachevalier J. Face processing abilities are altered by orbital frontal cortex lesion in adult monkeys (macaca mulatta). Society for Neuroscience meeting, Washington DC, 2008.
Grand, A.P., Sawyer, N.T., Maestripieri, D., Sanchez, M.M., McCormack, K.M. (2008). The long-term impact of maternal maltreatment on affiliative, aggressive, and defensive behavior in rhesus macaques. American Journal of Primatology, 70, 47, 2008.
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Guyer, A. E., McClure-Tone, E. B., Shiffrin, N. D., Pine, D. S., Nelson, E. E. (April, 2009). Neural Responses to Anticipated Peer Evaluation in Adolescent Development. In L. Steinberg (Chair), Neuroimaging Peer Relations in Adolescence: fMRI Studies of Peer Influence, Peer Evaluation, and Social Exclusion. A symposium presented at the 2009 Biannual Meeting of the Society for Research in Child Development
HAFTEL, V.K., K. STANSBURY, M. K. DEMETRIKOPOULOS. Formative evaluation of enhancement of an interdisciplinary neuroscience minor using new pedagogical approaches. Soc. Neurosci. Meeting, Washington, D.C., 2008.
Hall, J., S. Lacey & K. Sathian. Surface properties affect within- and cross-modal object recognition. IMRF 2009.

Hall, J.M., S. Lacey & K. Sathian. Differential effect of modality-specific and modality-independent surface properties on within- and cross-modal perception of shape. Society for Neuroscience, Washington, D.C., October 2008.
Hammoudi, Taymour, Hang Lu, Johnna Temenoff, "Photopatterned 3-Dimensional, Laminated Hydrogel Microstructures for Musculoskeletal Regeneration", BMES Annual Meeting, Oct 2008, St Louis, MO.
Hampstead, B.M., A. Y. Stringer, A. Amaraneni, R. F. Stilla & K. Sathian. Neural networks mediating memory retrieval following training on object-location associations in patients with mild cognitive impairment. Society for Neuroscience, Chicogo, Ill., 2009.
Hampstead, B.M., A. Y. Stringer, R. F. Stilla & K. Sathian. Behavioral and neural changes following training on object-location associations in patients with mild cognitive impairment. Organization for Human Brain Mapping, 2009.
Hampstead, B.M., R. F. Stilla, A. B. Moore, A. Y. Stringer, G. Deshpande, X. Hu & K. Sathian. Changes in neocortical activation and connectivity following explicit memory training in patients with mild cognitive impairment. Society for Neuroscience, Washington, D.C., October 2008.
*Hampton, R.R. (2008, October). International Society for Comparative Psychology, Buenos Aires, Argentina.
*Hampton, R.R. (2009, August). American Psychological Association, Toronto, Canada.
*Hampton, R.R. (2009, March). International Conference on Comparative Cognition, Melbourne, FL.
Hanberry, R and Murphy, A.Z. Sexually dimorphic Effects of aging on morphine analgesia and associated changes in μ-opioid receptor expression. Society for Neuroscience, Washington, D.C., 2008.
Hanberry, R. L. and Murphy, A. Z. Sexually dimorphic effects of aging on morphine analgesia and associated changes in μ-opioid receptor expression. Presented at the International Association for the Study of Pain 12th world congress in Glasgow, Scotland, 2009.
*Hassett, J.M., Herman, R.A., and Wallen, K. (2009). Pre- and Post-pubertal Changes in Mounting Partners in Rhesus Monkey Males: Seasonal Differences. Poster presented at the Society for Behavioral Neuroendocrinology meeting in East Lansing, MI, June 24-27, 2009.
Hayes, H., Chang, Y.-H., and S. Hochman. Mechanosensory effects on hindlimb locomotor function in an in vitro spinal cord-hindlimb rat preparation. Society for Neuroscience, Washington, DC, 2008.
Hayes, H., Chang, Y.-H., and S. Hochman. Modulation of sensory input and interneuronal activity during non-fictive locomotion in the in vitro spinal cord-hindlimb rat preparation. Society for Neuroscience, Chicago, IL, 2009.
Hazeltine E., Schumacher, E. H., & Schwarb, H. (2008). Sequential effects in a temporal flanker task. Presented at Neuroscience and Cognitive Control, Ghent, Belgium.
HAZRA, R., J. GUO, S. RYAN, A. M. JASNOW, D. G. RAINNIE. Genetic verification of physiologically defined cell types in the anterolateral bed nucleus of stria terminalis (BNSTALG): A single cell RT-PCR study. Society for Neuroscience Presentation, Chicago IL, 2009.
*Hecht EE, Barks SK, Preuss TM, Rilling JK, Votaw JR, Parr LA (2008). Functional neuroimaging of the neural correlates of face recognition in chimpanzees. Society for Neuroscience, Washington, D.C.
Hecht, E., Parr, L.A., Preuss, T.M. & Rilling, J.K. (2009). Neural basis for primate imitation. The Primate Mind, Erice, Italy, June 3-7, 2009.

*Heimbauer, L. A., Beran, M. J., & Owren, M. J. (April 2009). Perception of Voiced-Only and Noise- Vocoded Speech by a Language-Trained Chimpanzee (Pan troglogytes). 16th Annual Indiana Universtity CISAB Animal Behavior Conference, Bloomington, IN.
*Heimbauer, L. A., Beran, M. J., & Owren, M. J. (May 2009). Perception of Voiced-Only and Noise- Vocoded Speech by a Language-Trained Chimpanzee (Pan troglogytes). Acoustical Society of America, 157th meeting, Portland, OR
*Heimbauer, L. A., Beran, M. J., & Owren, M. J. (Nov. 2008). Speech perception in a language-trained chimpanzee (Pan troglodytes). Acoustical Society of America, 156th meeting, Miami, FL.
*Heimbauer, L. A., Beran, M. J., & Owren, M. J. (September 2009). Spoken Word Recognition by a Language-Trained Chimpanzee (Pan troglodytes) in the Absence of Traditional Cues to Speech Content: Implications for Speech Evolution. American Society of Primatologists 32nd Annual Meeting, San Diego, CA.
*Heimbauer, L. A., Conway, C. M., Christiansen, M. H., Beran, M. J., & Owren, M. J. (April 2009). Testing Sequence Learning in Rhesus Macaques (Macaca mulatta). Southern Society for Philosophy and Psychology annual meeting, Savannah, GA.
*Heldt, S.A., L. Mou, K. J. Ressler. In vitro and in vivo knocked down expression of GAD67 in the amygdala using a lentiviral-based RNA interference strategy. 2009 Society for Neuroscience Presentation, Chicago IL
Hirsch, Alison, Boyang Michael Zhang, Hang Lu, "Cell and Particle Behavior in Microfluidic Mixers", AIChE Annual Meeting, Nashville, TN, 2009
Hirsch, Alison, Catherine Rivet, Boyang Zhang, Melissa Kemp, and Hang Lu, "Parallel Multi-Time Point Cell Stimulus and Lysis in a Microfluidic Device Using Chaotic Mixing and Pressure Resistance," AIChE Annual Meeting, Nov 2008, Philadelphia.
Hirsch, Allison, and Hang Lu, "Modeling Experimental Platforms for Chemotaxis and the Implications for Evaluating Cellular Response", AIChE Annual Meeting, Nashville, TN, 2009
Hirsch. Alison, and Hang Lu, "Models and Analyses of Experimental Platforms for Chemotaxis and Their Implications for Evaluating Cellular Response", BMES Annual Meeting, Pittsburg, PA, 2009
Hoke, K., M. J. Ryan, and W. Wilczynski (2008) Activation of septal nuclei during frog reproductive behavior. Society for Neuroscience, Washington, D.C., 2008.
Howell B., Glasser M., Li W., Zhang X., Graff A., Maestripieri D., Hu X., Sanchez M. (2009). Long-term alterations in white matter microstructure in a rhesus macaque model of infant maltreatment measured using diffusion tensor imaging. 15th Annual Meeting of the Organization for Human Brain Mapping, June 18-22, 2009, San Francisco, CA.
Howell, B.R., McCormack, K.M., Grand, A., Styner, M., Hu, X., Zhang, X., Glasser, M., Maestripieri, D., Sanchez, M.M. (2009). Long-term effects of poor maternal care on the brain and behavior in rhesus macaques. Nanosymposium "Early Life Experience and the Emotional Brain". Annual Meeting of the Society for Neuroscience, Chicago, IL; Oct 17-21, 2009.
Hubert, G.W. and Kuhar, M.J. Cocaine- and amphetamine-regulated transcript (CART) peptide injected into the ventral pallidum (VP) inhibits cocaine-induced locomotion. Society for Neuroscience, Washington D.C., 2008.
*Huynh, L. Y., Maney, D. L., and Thomas, J. W. (2009). Genetics of a chromosomal inversion linked to behavior. Cold Spring Harbor Symposium on Quantitative Biology, Cold Spring Harbor, NY
*Huynh, L. Y., Maney, D. L., and Thomas, J. W. (2009). The genetics of an inversion

polymorphism in the white-throated sparrow. Society for Molecular Biology and Evolution, Iowa City, Iowa.
Ivanova, T., A. Matthews, C. Gross, G. J. Bassell, R. C. Liu, Compartmental analysis of auditory cortical Arc/Arg 3.1 mRNA expression induced by novel and familiar sounds, 39th Annual Meeting of the Society for Neuroscience, Chicago, IL, October 17-21, 2009.
Ivanova, T., C. Gross, G. Bassell, R. C. Liu, Compartmental analysis of sound-induced Arc/Arg 3.1 mRNA expression in mouse auditory cortex, 38th Annual Meeting of the Society for Neuroscience, Washington, DC, November 15-19, 2008.
Ivanova, T., C. Gross, G. Bassell, R. C. Liu, Compartmental analysis of sound-induced Arc/Arg 3.1 mRNA expression in mouse auditory cortex, Tucker-Davis Symposium on Advances and Perspectives in Auditory Neurophysiology, Washington, DC, November 14, 2008.
Jalil, S., I. Belykh and A.L. Shilnikov. Fast Reciprocal Inhibition Can Synchronize Bursting Neurons 2009 SIAM Conference on Application of Dynamical Systems, Snowbird, Utah, May 17-21 2009.
James, G.A., Z.L Lu, J. VanMeter, K. Sathian, X.P. Hu, A.J. Butler. Changes in resting-state motor network effective connectivity following upper-extremity rehabilitation in acute stroke. Organization for Human Brain Mapping, 2009.
*James, Shelli, Millicent Bright, Erica Lampkin, KaTerri Kelly, Jonell Belle A. Pai. Effect of social environment on evolution of reproductive traits in the red flour beetle, Tribolium castaneum. Poster Presentation, ABRCMS, Phoenix, AZ, 2009 .
*Jasnow, A.M., J. Guo, R Hazra, J. Dabrowska, K.J. Ressler, and D.G. Rainnie. Characterization of CRF-expressing neurons of the central amygdala and bed nucleus of the stria terminalis using CRF- GFP transgenic mice. Society for Neuroscience, Chicago, Ill., 2009.
*JASNOW, A.M., S. S. DAFTARY, D. G. RAINNIE. Modification of spike timing precision and high threshold oscillations by inhibitory synaptic input in basolateral amygdala neurons. Society for Neuroscience meeting, Washington, D.C., 2008.
*Jefferson F, Ehlen J.C., Paul, K.N. A dopamine receptor agonist reduces the ability of restraint stress to increase REM sleep. 38th Annual Meeting Society for Neuroscience, Washington, DC, 2008.
Jhala, S., A. Sakurai, J.L. Lillvis, P.S. Katz (2008) “Serotonergic innervation of the Aplysia tail nerve” Washington, DC: Society for Neuroscience, 2008.
JOHNSON, P.L., A. MOLOSH, S. D. FITZ, J. A. DIMICCO, D. G. RAINNIE, J. P. HERMAN, A. SHEKHAR. Hypertonic sodium lactate or sodium chloride, but not D-mannitol, induce panic-like responses in an animal model of panic disorder involving reduced GABA inhibition in the dorsomedial hypothalamus. Society for Neuroscience meeting, Washington, D.C., 2008.
Jones, D.C. and Kuhar, M.J. The effect of Bisphenol A on the rat dopamine system and cocaine-induced behaviors. Society for Neuroscience, Washington D.C., 2008.
Jones, Gregory Todd & Brosnan, Sarah F. (April, 2009) Simmelian Ties in Chimpanzees: Social Structure and the Evolution of Reciprocity, Society for Evolutionary Analysis in Law, Vanderbilt University Law School, Nashville, Tennessee.
Jones, Gregory Todd & Brosnan, Sarah F. (April, 2009) Social Contracts on Social Networks: Local Patterns of Interaction, Local Strategy Dynamics and the Emergence of Reciprocity, Workshop on Context and the Evolution of Mechanisms for Solving Collective Action Problems, Workshop in Political Theory and Policy Analysis at Indiana University, Indiana University School of Law, & The Gruter Institute for Law and Behavioral Research, Bloomington, Indiana.
Jones, Gregory Todd & Brosnan, Sarah F. (June, 2009) The Importance of Simmelian Ties:

Social Network Decomposition and the Emergence of Reciprocity, International Association for Conflict Management, Kyoto, Japan.
*Jovanovic T, Norrholm S, Blanding N, Graham A, Davis M, Duncan E, Bradley B, Ressler K. Fear conditioning biomarkers of PTSD symptoms in a traumatized civilian population. Presented at Annual Meeting, International Sociaty for Traumatic Stress Studies, Atlanta GA, 2009.
*Jovanovic T, Norrholm SD, Blanding NB, Bradley R, Duncan E, Ressler KJ. Physiological endophenotypes of posttraumatic stress disorder symptoms. Presented at Annual Meeting, American College of Neuropsychopharmacology, Scottsdale, AZ, 2008.
*Jovanovic T, Norrholm SD, Blanding NQ, Davis M, Duncan E, Bradley R, Ressler KJ. Fear inhibition is impaired in PTSD but not depression. Presented at Annual Meeting, Society of Biological Psychiatry, Vancouver, BC, 2009.
Jutras, M.J., and E.A. Buffalo (2009). Theta-band oscillations in the primate hippocampus are modulated by saccades during a fee-viewing task. Society for Neuroscience, Chicago, IL., 2009.
Jutras, M.J., P. Fries, and E.A. Buffalo (2008). Hippocampal activity reflects recognition memory on a trial-by-trial basis. Washington, DC: Society for Neuroscience, 2008.
Kamio, M. 2009 Sex pheromones in blue crabs, Callinectes sapidus. At The Crustacean Society Summer Meeting, Tokyo, Japan, September 20-24, 2009.
Kamio, M., L. Nguyen, T.V. Grimes, M. Nusnbaum, M.H. Hutchins, S. Yaldiz, R. van Dam, and C.D. Derby. 2009. Sea hares chemically defend themselves from predatory blue crabs and bluehead wrasse using light-harvesting molecules in their algal diet. Association for Chemoreception Sciences, Sarasota, FL, April 2009
Kamio, M., L. Nguyen, T.V. Grimes, M.H. Hutchins, S. Yaldiz, R. van Dam, C.D. Derby. 2009. Chemical defense by light-harvesting molecules in sea hares, Aplysia californica and Aplysia dactylomela. Benthic Ecology Conference, Corpus Christi, TX. March 4-7, 2009.
Kathryn Gaylord, H G. Hoffman, Alan Maiers, C Maani, S D. Miyahira, A Garcia-Palacios, B Rothbaum and J Difede (June 2009). VR Exposure Therapy + D-Cycloserine (DCS) for Treating PTSD in Patients with Combat-Related Burn Injuries. Submitted for presentation at Cybertherapy.
Katz, P.S., A. Sakurai, E.S. Hill, C.A. Gunaratne (2008) “Interactions of state-dependent and state- independent neuromodulation account for spike-timing dependent neuromodulation” Washington, DC: Society for Neuroscience, 2008.
Killian, N., M.J. Jutras, and E.A. Buffalo (2009). Recognition memory signals in the macaque entorhinal cortex: a laminar analysis. Society for Neuroscience, Chicago, IL., 2009.
*Kinkead, Becky, Jianjun Wang, Erica Duncan, Kristie M Mercer, Joseph F Cubells, Kerry J Ressler, Rebekah G Bradley, Charles B Nemeroff, Elisabeth B Binder. Functional promoter variant in the neurotensin gene is associated with increased cocaine use in African American subjects. American College of Neuropsychopharmacology, Scottsdale, Arizona, 2008.
Kubanek J (2008) Chemical warfare in the marine plankton, 5th World Allelopathy Congress, Saratoga Springs, NY
Kubanek J (2009) Chemical ecology leads for drug discovery. NIH symposium on Natural Products and Biomedical Science, National Institutes of Health, Bethesda, MD,USA
Kubanek J (2009) Chemical warfare in the ocean, Wake Forest University, Department of Chemistry, Winston-Salem, NC, USA
Kubanek J (2009) Marine natural products: Roles in animal health and drug discovery, Georgia Aquarium, Atlanta, GA, USA
Kubanek J (2009) War in the plankton: Phytoplankton insurgency tactics undermine harmful

algal blooms and their toxins, Northwest Fisheries Science Center, Seattle, WA, USA
Kubanek J, Stout EP, Snell TW (2009) Progesterone is a regulator of reproduction in Brachionus manjavacas (Rotifera). Rotifera XII , Berlin, Germany
Lacey, S., M. Pappas, A. Kreps, K. Lee & K. Sathian. View-independence of visuo-haptic object representations. Cognit Neurosci Soc, 2009
Lacey, S., R. Stilla, G. Gibson & K. Sathian. Segregated and multisensory processing of texture and location in vision and touch. Society for Neuroscience, Chicogo, Ill., 2009.
Lacey, S.A., A. Anderson, R. Stilla, K. Sathian. Metaphorically feeling: somatosensory texture-selective cortex is active during comprehension of textural metaphors. Society for Neuroscience, Washington, D.C., October 2008.
Lahey, B.B., & Waldman, I.D. Testing the Association of Birth Weight and Child Conduct Problems Using a Discordant Monozygotic Twin Design. Paper presented in the Symposium on Quasi- Experimental Studies of Early Risk Factors for Offspring Psychopathology at the Biennial meeting of the Society for Research in Child Development, April 2-4, 2009, Denver, Colorado.
Lam K, Foeller P, Bradley D, Tychsen L, Wong AM (2009). Defining the critical period for eye alignment development in infant primates: Effects of binocular decorrelation. Paper presented at the Annual Meeting of the Canadian Association of Pediatric Ophthalmologists, Toronto, June,2009.
*LaRocca, SA, Markham, CM, Norvelle, A, and Huhman, KL (2008). Role of the bed nucleus of the stria terminalis in the acquisition and expression of conditioned defeat. Presented at the Annual Meeting for the Society for Neuroscience, Washington, D.C.
Lee, Hyewon, Kwanghun Chung, and Hang Lu, "Pressure Measurement in Microsystems Using Volume-Displacement of Nanoparticle Suspension", AIChE Annual Meeting, Nashville, TN, 2009
*Leimbach LB, Daugherty MD, Russ E, Crowe C, Skelton K, Jovanovic T, Ressler K, Duncan E, Bradley B, Norrholm SD. (2009). Conditioned fear acquisition, discrimination, and extinction in combat veterans from Operation Iraqi Freedom (OIF) with posttraumatic stress disorder (PTSD). Presented at Annual Meeting, Georgia/South Carolina Neuroscience Consortium, Athens, GA, 2009.
*Leung, C. H., Goode, C. T., and Maney, D. L. (2009). Distribution of vasotocin receptor mRNA in two species of songbird. Society for Behavioral Neuroendocrinology, East Lansing, MI.
Levey, Allan. Center for Lifelong Learning. Memory Loss and Alzheimer's Disease: Preventing an Epidemic. Emory University. October 7, 2008
Levey, Allan. MENSA Southeast Regional Meeting. Medical Aspects of Memory. Atlanta, GA. October 4, 2008.
Levey, Allan. Ninth International Conference on Alzheimer's Disease/Parkinson's Disease. Muscarinic Receptor Regulation Of Amyloid Precursor Protein Processing. Prague, Czech Republic. March 13, 2009.
Levey, Allan. Primary Care Medicine and Neurology Update for the Primary Care Provider. Mild Cognitive Impairment and Alzheimer's Disease. Chattanooga, TN. June 27, 2009.
Levey, Allan. Provosts' Life of the Mind Seminar Series. Life of the Failing Mind. Emory University. January 22, 2009.
Levey, Allan. Twenty-First Winter Conference on Neural Plasticity. Symposium: Looking Back to See the Future. Barbados, Caribbean. February 9, 2009

*Lewis, C.M. & Petrulis, A. (2008) Neural encoding of male and female odors in the medial amygdala of male Syrian hamsters. Society for Neuroscience, Washington D.C.
Li L, Preuss TM, Rilling JK, Hopkins WD, Glasser MF, Kumar B, Nana R, Zhang Z, Hu X. 2009. Asymmetries in female chimpanzees (Pan troglodytes) primary motor system - A diffusion magnetic resonance imaging (MRI) study. International Society for Magnetic Resonance Imaging in Medicine, 2009.
LI, C., D. G. RAINNIE. Forskolin attenuates group II mGluR-induced synaptic depression through a presynaptic mechanism in the basolateral amygdala. Society for Neuroscience Presentation, Chicago IL, 2009.
*Li, C., Doherty, J.M., Lee, A., Frantz, K.J. (2009) No age differences in cue-induced reinstatement of sucrose-seeking in male rats. Society for Neuroscience meeting, Chicago, Il, 2009.
Lightman, E. J., Schwarb, H., Hazeltine, E., Patel, N., & Schumacher, E. H. (2009). Investigating control mechanisms with and between modality with a temporal flanker task. Poster presented at the annual meeting of the Cognitive Neuroscience Society, San Francisco, CA
Lillvis JL and Katz PS. Identification of a FMRFamide-like immunoreactive neuron in the cerebral ganglion of Aplysia californica. Molluscan Neuroscience Meeting: Recent Advances and New Vistas. San Juan, Puerto Rico, 2009.
*Lillvis, J.L., and P.S. Katz (2008) "Identification of a FMRFamide-like immunoreactive neuron in the cerebral ganglion of Aplysia californica" Washington, DC: Society for Neuroscience, 2008.
Lima, F.B., Henderson, J.A., Reddy, A.P., Hubert, G.W., Tokuyama, Y., Kuhar, M.J., and Bethea, C.L. Unique responses of midbrain CART neurons in macaques to ovarian steroids. Society for Neuroscience, Washington D.C., 2008.
Lin, F.G., E. E. Galindo-Leon, J. A. Miranda, R. C. Liu, Plasticity in pup call evoked cortical inhibition reflects differences in maternal experience, 39th Annual Meeting of the Society for Neuroscience, Chicago, IL, October 17-21, 2009.
Lin, F.G., E. E. Galindo-Leon, R. C. Liu, Inhibitory plasticity in a lateral band improves cortical detection of natural vocalizations, Auditory Cortex 2009, Magdeburg, Germany, August 29-Sept 2, 2009.
Lin, F.G., E. E. Galindo-Leon, R. C. Liu, Predicting first spikes at the onset of natural calls in the awake mouse auditory cortex, 38th Annual Meeting of the Society for Neuroscience, Washington, DC, November 15-19, 2008.
Lin, F.G., E. E. Galindo-Leon, R. C. Liu, Predicting first spikes at the onset of natural calls in the awake mouse auditory cortex, Tucker-Davis Symposium on Advances and Perspectives in Auditory Neurophysiology, Washington, DC, November 14, 2008.
Liu, R.C. Hearing ultrasounds: Neural activity in auditory cortex correlates with communicative significance, Symposium on the Ultrasonic vocalizations as a social indicator in rodents at the International Behavioural and Neural Genetics Society, Dresden, Germany, June 4-8, 2009.
Liu, R.C. Neurobiology of vocal communication in rodents, Workshop on the Neural Processing of Communication Calls at the Tucker-Davis Symposium on Advances and Perspectives in Auditory Neurophysiology, Washington, DC, November 14, 2008.
Liu, R.C. Of Mice and Moms: A computational neuroethological approach to acoustic communication, Albert Einstein College of Medicine Neuroscience Seminar, Bronx, NY, April 15, 2009.
Liu, R.C. Of Mice and Moms: Auditory processing of behaviorally relevant vocalizations,

University of Ulm, Ulm, Germany, June 9, 2009.
Liu, R.C., F. G. Lin, E. E. Galindo-Leon, Predicting first spikes at the onset of natural calls in the awake mouse auditory cortex, Gordon Research Conference on The Auditory System, Colby-Sawyer College, NH, June 29-July 4, 2008.
Liu, R.C.Infant mouse isolation ultrasounds: production, perception and neural plasticity, Special Session on "Emotion-related Mechanisms of Mammalian Vocalizations" at the 158th Meeting of the Acoustical Society of America, San Antonio, TX, October 26-30, 2009.
Lu, Hang. ":Microfluidic Maneuver of Biological Systems - from molecules to worms", Atlanta Area Soft Matter and Complex Systems Symposium, Oct 25, 2008.
Lu, Hang. "Automated On-Chip Rapid Microscopy, Phenotyping, and Sorting of C. elegans," American Vacuum Society BioMEMS workshop, sponsored by NIH-NIBIB and DARPA-MTO, Boston, MA, October 21, 2008.
Lu, Hang. "Manipulating cells and multicellular organisms in microfluidics", Department of Mechanical Engineering, Cornell University, Oct 16, 2009.
Lu, Hang. "Manipulating cells and multicellular organisms in microfluidics", Gordon Research Conference on Physics and Chemistry of Microfluidics, Lucca, Italy, June 28-July 3, 2009.
Lu, Hang. "Microfluidic Maneuver of Biological Systems - from molecules to worms", Atlanta Area Soft Matter and Complex Systems Symposium, Oct 25, 2008.
Lu, Hang. "Microfluidic opportunities for C. elegans research", Mount Desert Island Biological Laboratory, Maine, August 28, 2009.
Lu, Hang. "Microfluidics - engineering flow at tiny scales for biosciences and medicine", SURE summer program, Georgia Tech, June 2009.
Lu, Hang. "Microfluidics platforms for neuroscience and systems biology", Department Bioengineering, University of Pennsylvania, Oct 1, 2009.
Lu, Hang. "Probing Worm Brains, Cell Behavior, and Polymer Solution with Microfluidics", DuPont Central Research and Development, Wilmington, DE, November 7, 2008
Luckett, CA, Markham, CM, Norvelle, A, and Huhman, KL (2008). Behavioral responses to social defeat: A novel model for human psychiatric disorders? Brain Research Meeting: Stress, Coping and Disease, November 13-14, 2008.
*Luckett, CA, Markham, CM, Norvelle, A, and Huhman, KL (2008). Does inhibition of protein synthesis in the VHA block the acquisition of conditioned defeat? Presented at the Annual Meeting for the Society for Neuroscience, Washington, D.C.
*Lutterschmidt, D. I., and Wilczynski, W. (2009) Influence of melatonin on arginine vasotocin immunoreactivity in green treefrogs (Hyla cinerea). Society for Neuroscience, Chicago, Ill., 2009.
Lutterschmidt, D.I. and R.T. Mason. 2009. Endocrine mechanisms mediating temperature-induced reproductive behavior in garter snakes (Thamnophis sirtalis). Annual Meeting of the Society for Integrative and Comparative Biology. Boston, Massachusetts.
*Lutterschmidt, D.I. and W. Wilczynski. 2009. Melatonin alters arginine vasotocin immunoreactivity in green treefrogs (Hyla cinerea). Annual Meeting of the Society for Integrative and Comparative Biology. Boston, Massachusetts.
*Lutterschmidt, D.I., and W. Wilczynski (2009) Kisspeptin-like immunoreactive neuron distribution in green treefrogs (Hyla cinerea). Society for Comparative and Integrative Biology.
*Madsen T.E., D.G. Rainnie. (October 17-21, 2009) Local field potentials in the rat basolateral amygdala and medial prefrontal cortex show coherent oscillations in multiple frequency bands during fear. Poster presented at the 2009 Annual Meeting of the Society for Neuroscience in

Chicago, IL.
*Madsen T.E., L.C. Guillory, H.S. Mayberg, D.G. Rainnie. (November 15-19, 2008) Deep brain stimulation targeting the rat infralimbic cortex modulates neuronal activity and local field potential oscillations in the basolateral amygdala. Society for Neuroscience in Washington, D.C., 2008.
*Madsen T.E., O.L. Smart, A.J. Peters, L.C. Guillory, H.S. Mayberg, D.G. Rainnie. (July 12-17, 2009) Deep brain stimulation targeting the rat infralimbic cortex modulates locomotor activity and local field potential oscillations in the basolateral amygdala. Gordon Research Conference, "Amygdala in Health & Disease:Contributions to Emotional Memories," at Colby College in Waterville, ME.
Magnuson, ME, W Majeed, S Keilholz. Mapping Functional Connectivity in the Anesthetized Rat using CBV vs BOLD. Proc Int Soc Magn Reson Med 2009;1656.
*Maguschak, K.A., K. J. Ressler. Wnt/β-catenin signaling in the amygdala during memory formation. 2009 Society for Neuroscience Presentation, Chicago IL
Main, K. L., Adelore, T. A., Kinzel, E. N., Moloney, K. P., Metcalfe, L., Palvia, V., Blanton, Z., Primo, S. A., Ginn, J., Jacko, J. A., & Schumacher, E. H. (2009, March). Reorganization of attentional networks with cortical deafferentation. Poster presented at the 16th annual meeting of the Cognitive Neuroscience Society.
Main, K. L., Moloney, K. P., Kinzel, E. N., Ginn, J., Adelore, T. A., Metcalfe, L., Palvia, V., Blanton, Z., Primo, S. A., Jacko, J. A. & Schumacher, E. H. The use of preferred retinal locations and the reorganization of attentional networks. Poster presented at the 38th annual meeting of the Society for Neuroscience, November, 2008.
Majeed, W, M Magnuson, S Keilholz. Functional Connectivity Mapping in the Rat Brain using Spin- Echo EPI. Proc Int Soc Magn Reson Med 2009;1666.
Majeed, W, M Magnuson, S Keilholz. Exploration of Functionally Connected Networks in the Rat Brain using Multislice fMRI. Proc Int Soc Magn Reson Med 2009;1667.
Majeed, W, M Magnuson, S Keilholz. Stimulus Induced Modulation of Low Frequency Fluctuations in BOLD fMRI of the Rat. Proc Int Soc Magn Reson Med 2009; 1581.
*Mao, Y.-T., S.L. Pallas (2009) Compensation and compromise of cortical function after neonatal midbrain damage. Society for Neuroscience, Chicago, IL, 2009.
*Mao, Y.-T., S.L. Pallas (2009) Recovery of cortical function after neonatal midbrain damage. GA/SC Neuroscience Consortium, UGA, Athens, GA, 2009.
*Maras, P.M. and Petrulis, A. Excitotoxic lesions of the anterior medial amygdala reduce Fos expression within the posterodorsal medial amygdala in response to female or male odors Society for Behavioral Neuroendocrinology, East Lansing, MI, 2009.
*Maras, P.M. and Petrulis, A. Lesions that disconnect the anterior and posterodorsal regions of the medial amygdala eliminate opposite-sex odor preferences in male Syrian hamsters. Society for Neuroscience, Chicago, IL, 2009.
*Maras, P.M. and Petrulis, A. Social odor processing within sub-regions of the medial amygdala: functional interactions and chemical phenotype. Society for Neuroscience, Washington D.C., 2008.
*Markham, C. M.; Taylor, S. L.; Huhman, K. L. Role of amygdala and hippocampus in the neural circuit subserving conditioned defeat in Syrian hamsters. Society for Neuroscience meeting, Chicago, Ill., 2009.
*Markham, CM and Huhman, KL (2009). Unilateral inactivation of the basolateral amygdala (BLA) in hamsters inhibits social defeat-stimulated fos-immunoreactivity in the contralateral

BLA. Presented at the Annual Meeting for the Society for Neuroscience, Chicago, IL.
*Markham, CM, Taylor, SL, LaRocca, SA, Luckett, C, Norvelle, A, and Huhman, KL (2008). Role of basolateral amygdala-ventral hippocampus interactions in the acquisition of conditioned defeat. Presented at the Annual Meeting for the Society for Neuroscience, Washington, D.C.
*Martin, Elizabeth I., Zhongjian Chen, Jasmeer P. Chaatwal, Donald G. Rainnie, Aaron Jasnow, Charles B. Nemeroff, Kerry J. Ressler, Michael J. Owens. Novel transgenic mouse as a tool for gene- targeting within CRF-expressing cells. American College of Neuropsychopharmacology; Phoenix, Arizona, 2008.
MARTIN, M., B. SOWELL, C. SPEARS, V. K. HAFTEL. The effect of uncontrolled diabetes on rat movement behavior. Soc. Neurosci. Meeting, Washington, D.C., 2008.
*Martinez, L. & Petrulis, A. Progesterone inhibits vaginal marking in ovariectomized, estradiol benzoate-primed female Syrian hamsters. Poster presentation at 13th annual meeting of the Society for Behavioral Neuroendocrinology, East Lansing, Michigan, June, 2009.
*Martinez, L., Petrulis, A., & Albers, E. Endogenous oxytocin in the medial preoptic-anterior hypothalamus facilitates vaginal marking and opposite-sex odor preference in female Syrian hamsters. Society for Neuroscience annual meeting, Washington, D.C., 2008.
Masuda, A., Price, M., Anderson, P. L., Schmertz, S. K., & Calamaras, M. R. (2008, November). The role of psychological flexibility in mental health stigma and psychological distress for the stigmatizer. In R. Vilardaga (Chair), The impact of stigma in professionals and clients. Symposium conducted at the Association for Behavioral and Cognitive Therapies, Annual Meeting, Orlando, Florida, 2008.
*Matragrano, L.L., Sanford, S.E., Salvante, K.G., Sockman, K.W., and Maney, D.L. (2009). Effects of estradiol on catecholaminergic innervation of auditory areas in a female songbird: Comparison of immunohistochemistry and HPLC. Society for Neuroscience Abstracts, Chicago, IL.
McClure-Tone, E. B. (November, 2008). fMRI Predictors of Treatment Outcome in Anxiety Disorders. In A. Roy (Chair), Change Your Thoughts . . . Change Your Brain: Applying fMRI to the Treatment of Anxiety Disorders. A symposium accepted for presentation at the 2008 Association for Behavioral and Cognitive Therapies Annual Meeting, November, 2008.
*McCormack, K., Warfield, J., Dozier, M., Gunnar, M. R., Maestripieri, D., Waters, E., & Sanchez, M.M. (2009). Measuring attachment security in captive rhesus macaques (Macaca mulatta). American Journal of Primatology, San Diego, CA, 2009.
*McGraw, Lisa, Young, L.J. Experimental evolution of pair bonding in the prairie vole (Microtus ochrogaster). 12th Congress of the European Society of Evolutionary Biology. Aug. 24-29, 2009. Turin, Italy.
*McGraw, Lisa, Young, L.J. Experimental evolution of pair bonding in the prairie vole (Microtus ochrogaster). 8th World Congress on Neurohypophysial Hormones. Sept. 4-8, 2009 Kitakyushu, Japan.
*McGraw, Lisa, Young, L.J. Intraspecific variation and social systems: Explaining variation based on neuroendocrine and genetic mechanism. Pontificia Universidad Católica de Chile, Santiago, Chile. Aug. 4-8, 2009.
*McGraw, Lisa, Young, L.J. Mammalian sociogenomics: Developing genomic resources for the prairie vole (Microtus ochrogaster). Vole Meeting Feb. 28, 2009. Atlanta, GA.
*McGraw, Lisa, Young, L.J. Mammalian sociogenomics: Developing genomic resources for the prairie vole (Microtus ochrogaster). Cold Spring Harbor Laboratory meeting on the Biology of Genomes. Cold Spring Harbor, NY. May 5-9, 2009.

*McManus, S.M., Rozga, A., Zaj, J.L., King, T.Z., & Robins, D.L. (2009, May). Emotion perception during an audio-visual emotion perception task: Differences between forced-choice and free response formats in individuals with autism spectrum disorders and typically-developing individuals. Poster presented at the International Meeting for Autism Research, Chicago, IL.
Michopoulos V, Berga SL, Kaplan JR, Wilson ME. Social Subordination, Serotonin Transporter Gene Polymorphisms, and Cortisol influence agonistic behavior and luteinizing hormone secretion in female monkeys. Society for Behavioral Neuroendocrinology 2009, East Lansing, MI.
Michopoulos, V., KN Shepard, M Arce, JA Whitley, ME Wilson. Food history and social status affect food intake in monkeys. Society for the Study of Ingestive Behavior, July 2009, Portland, OR.
Michopoulos, V., M Arce, KN Shepard, ME Wilson. Behavioral and hormonal responses to diet choice and calorie consumption are influenced by social subordination in female rhesus macaques. Society for Neuroscience, October 2009, Chicago, IL.
Michopoulos, V., Sanchez, M.M., Votaw, J.R., Rivier, J., Loucks, T.L., Wilson, M.E., Berga, S.L. (2009). CRH receptor antagonism modifies central GABA receptor binding in a model of social subordination stress. 48th Annual Meeting of the American College of Neuropsychopharmacology (ACNP), Dec 7-11, Hollywood, FL.
Micklewright, J.L., King, T.Z., O'Toole, K, Henrich, C., Floyd, F.J., McClure Tone, E. B., & Schmitz, M.L. (2008, October). The conditional indirect effect of parental distress on child externalizing behavior problems and adaptive socialization skills following traumatic brain injury. Poster presented at the annual meeting of the National Academy of Neuropsychology, New York, NY.
Miles, L.A., D.L. Walker, M. Davis. (2008,November). Corticotropin-releasing factor (CRF) type 1 receptors in the bed nucleus of the stria terminalis (BNST) mediate long- (minutes) but not short- (seconds) duration startle increases to shock-predicting cues. Society for Neuroscience, Washington D.C.
Miles, L.A., D.L. Walker, M. Davis. (2009, April). Corticotropin-releasing factor (CRF) type 1 receptors in the bed nucleus of the stria terminalis (BNST) mediate long- (minutes) but not short-(seconds) duration startle increases to shock-predicting cues. Center for the Integrative Study of Animal Behavior, Indiana University.
Miles, L.A., D.L. Walker, M. Davis. (2009, May). Corticotropin-releasing factor (CRF) type 1 receptors in the bed nucleus of the stria terminalis (BNST) mediate long- (minutes) but not short-(seconds) duration startle increases to shock-predicting cues. Molecular and Systems Pharmacology Symposium, Atlanta, GA
Miles, L.A., D.L. Walker, M. Davis. (2009,June). Examination of Phasic versus Sustained Fear Responses Using a Novel Sustained Fear Paradigm International Behavioral Neuroscience Society, Nassau, Bahamas.
Miles, L.A., M. Davis. (2009,October). Examination of phasic versus sustained fear responses in male and female rats using a novel Sustained Fear Conditioning paradigm. Society for Neuroscience. Chicago, IL.
Miranda, J.A., Kathryn N. Shepard, R. C. Liu, Maternal context influences the timing of neural responses in the early auditory system, Tucker-Davis Symposium on Advances and Perspectives in Auditory Neurophysiology, Chicago, IL, October 16, 2009.
Miranda, J.A., R. C. Liu, Maternal context influences the timing of neural responses in the early

auditory system, 39th Annual Meeting of the Society for Neuroscience, Chicago, IL, October 17-21, 2009.
Mizelle J.C. & Wheaton L.A. Neural Activation for Identification of Correct Versus Incorrect Tool- Object Pairs. Nanosymposium. 39th Annual Meeting of the Society for Neuroscience, Chicago, IL, 2009.
Modi, ME, and LJ Young. D-Cycloserine Enhances Social Cognition in an Animal Model Relevant to Autism. International Meeting for Autism Research Chicago, IL, 2009.
Modi, ME, and LJ Young. D-Cycloserine Enhances Social Cognition in an Animal Model Relevant to Autism. Keck Center for Behavioral Research Symposium. North Carolina State University. January, 2009.
Modi, ME, and LJ Young. D-Cycloserine Enhances Social Cognition in an Animal Model Relevant to Autism. 2009 RIKEN Brain Science Summer Program, Tokyo, Japan, 2009.
Modi, ME, and LJ Young. Prairie Voles as a Model for the Development of Novel Theraputics to Enhance Social Cognition: The effects of D-cycloserine. Vole Research Conference, Atlanta, GA, February, 2009.
Modi,ME, and LJ Young. D-Cycloserine Enhances Social Cognition in an Animal Model Relevant to Autism. Society for Neuroscience Washington, DC, 2008.
Moore, T.O., A. Bias, and S. Morganfield. The neurobehavioral effects of phytoestrogens on male hamsters in a psychosocial conflict experiment. Society for Neuroscience, October 17-21, Chicago, Illinois, 2009.
Morganfield, S., A. Bias and T. Moore (2009). Dietary manipulations can alter brain receptors. AAAS National HBCU UP National Research Conference, October 29-31, Washington, DC.
Mou, L., S. A. Heldt, K. J. Ressler. Internalization and decrease of GABA(A) alpha1 subunits caused by BDNF in cultured mouse hippocampus neurons. 2009 Society for Neuroscience Presentation, Chicago IL.
MULY, E.C., M. SENYUZ, J. GUO, Z. U. KHAN, D. G. RAINNIE. D1 and D5 dopamine receptors in primate amygdala. Society for Neuroscience meeting, Washington, D.C., 2008.
Murphy, A.Z. Impact of Advanced Age on Pain Sensitivity and Opiate Analgesia. International Association for the Study of Pain, Glasgow, Scotland, 2008.
Murphy, A.Z. Long-term Impact of an Adverse Neonatal Environment. Society for Behavioral Neuroendocrinology, Groningen, Netherlands, 2008.
Nails, B. & Chang, T.R. (2008). Human Visual Preference Using Fractals. Paper presented at the Nineteenth Annual Frederick Everett Mapp Science and Mathematics Symposium, Morehouse College, Atlanta, GA
Neigh, G.N. Behavioral consequences of small cerebral infarcts: examining cause and effect in a rat model. The American Association of Geriatric Psychiatry Annual Meeting, Honolulu, Hawaii, March 7, 2009
Neigh, G.N. Cognitive function in animal models of cerebral ischemia. International Symposium on Cerebral Blood Flow, Chicago, IL, June 29 – July 3, 2009.
Neigh, G.N. and Shurte, M. Affective and cognitive consequences of small cerebral infarcts. XXIVth International Symposium on Cerebral Blood Flow, Metabolism and Function, Chicago, IL, June 29 – July 3, 2009.
Neigh, G.N., Bourke, C., Binder, E. Chronic stress during puberty causes upregulation of glucocorticoid receptor chaperones. The American College of Neuropsychopharmacology Annual Meeting in Hollywood, FL, December 6-10, 2009
Neigh, G.N., Bourke, C., Raees, M., Binder, E. Chronic stress during puberty causes

upregulation of glucocorticoid receptor chaperones. Society for Neuroscience Annual Meeting, Chicago, IL, October 17-21, 2009

Neigh, G.N., Karelina, K., Zhang, N., Plotsky, P.M., Owens, M.J., Nemeroff, C.B., DeVries, A.C. Augmented negative feedback on the hypothalamic pituitary adrenal axis and increased CRF R1 binding after long term recovery from cardiac arrest and cardiopulmonary resuscitation. The American College of Neuropsychopharmacology Annual Meeting, Scottsdale, Arizona, December 7-11, 2008

Neigh, G.N., Shurte, M.S., Nemeroff, C.B. Microembolism-induced changed in affective behavior of the rat. The Society for Neuroscience Annual Meeting, Washington, D.C., November 16, 2008.

Nelson, E., Guyer, A. E., McClure-Tone, E. B., Pine, D. S. (April, 2009). Neural response to receipt of peer feedback in adolescence. In K. Ehrlich, & J. Cassidy (Chairs), Fear of Social Rejection in Adolescence: Physiological, Behavioral, and Relationship Processes. A symposium presented at the 2009 Biannual Meeting of the Society for Research in Child Development.

Nemeth, C. and Neigh, G.N. Microembolism infarcts generate depressive-like behavior in rats. To be presented at: Society for Neuroscience Annual Meeting, Chicago, IL, October 17-21, 2009.

Newsome, R, Dulas, MR and Duarte, A. The Effects of Self-Referential Processing on Source Memory in Young and Older Adults: ERP Evidence. Society for Neuroscience, Chicago, Ill., 2009

Nikolic, M., Wiggins, L.D., & Robins, D.L. (2009, May). The effect of auditory sensory abnormalities on language development in young children with autism spectrum disorder. Poster presented at the Georgia Psychological Society, Atlanta, GA.

Normandin, J. and Murphy, A.Z. Excitotoxic lesions of the nucleus paragigantocellularis facilitate sexual behavior in male but not female rats. Soc. Neurosci. Meeting, Chicago, Ill., 2009.

Normandin, J. and Murphy, A.Z. Excitotoxic lesions of the nucleus paragigantocellularis facilitate sexual behavior in male but not female rats. Soc. Behavioral Neuroendocrinology, 2009.

*Norrholm S, Jovanovic T, Leimbach L, Bradley B, Duncan E. Fear extinction in veterans from Operation Iraqi Freedom (OIF) with posttraumatic stress disorder. Presented at Annual Meeting, International Sociaty for Traumatic Stress Studies, Atlanta GA, 2009.

*Norrholm SD, Cuthbert B, Davis M, Duncan EJ. Time course of acoustic startle changes in cocaine dependence. Presented at Annual Meeting, American College of Neuropsychopharmacology, Scottsdale, AZ, 2008.

*Norrholm SD, Jovanovic T, Blanding N, Binder E, Bradley R, Duncan E, Ressler K. Conditioned fear inhibition and civilian trauma: Effects of corticotropin-releasing hormone type 1 receptor (CRHR1) gene polymorphisms. Presented at Annual Meeting, American College of Neuropsychopharmacology, Scottsdale, AZ, 2008.

*Norrholm SD, Jovanovic T, Skelton K, Bradley B, Duncan E, Ressler K. Conditioned fear extinction in combat and civilian traumatized populations with PTSD. To be presented at Annual Meeting, American College of Neuropsychopharmacology, Hollywood, FL, 2009.

*Norrholm SD, Leimbach L, Crowe C, Skelton K, Jovanovic T, Ressler K, Bradley R, Duncan E. Conditioned fear acquisition, discrimination, and extinction in combat veterans from Operation Iraqi Freedom (OIF) with posttraumatic stress disorder (PTSD). Presented at Annual Meeting, Society of Biological Psychiatry, Vancouver, BC, 2009.

Nusnbaum, M., M. Kamio, R. van Dam, and C.D. Derby. 2009. Mechanisms of deterrence by sea hare ink against bluehead wrasse, a generalist predator. Benthic Ecology Conference, Corpus Christi, TX. March 4-7, 2009.
Ogaga-Mgbonyebi, Ejiro V., Russell, Nancy V., Clancy, Andrew N. Actions of selective estrogenic drugs in the medial amygdale on male rat mating behavior. Poster P3.23: Presented at the Annual Meeting of the Society for Behavioral Neuroendocrinology, Michigan State University, June 27, 2009.
Okere, Chuma. Increased expression of microglia- specific ionized calcium binding adaptor protein (Iba1) in the accessory olfactory bulb during the formation of olfactory recognition memory in female mice. 39th Annual Conference of the Society for Neuroscience, Chicago Oct 17-21, 2009
Oliver, K.B., Robins, D.L., & Hazzard, A.P. (2009, May). The influence of culture on caregiver response when completing the Modified Checklist for Autism in Toddlers (M-CHAT). Poster presented at the International Meeting for Autism Research, Chicago, IL.
Ortigo D, Guarnaccia C, Ortigo K, Ressler K, Bradley RG Posttraumatic Stress Disorder and Parenting: Examining a Mechanism of Trans-generational Risk (2008) International Society of Traumatic Stress Studies, Chicago, Illinois.
Ortigo K, Castleberry J, Guarnaccia C, Ressler K, Bradley RG (2008) Attachment, Personality, and Posttraumatic Stress Symptoms in a Traumatized Urban Population. International Society of Traumatic Stress Studies, Chicago, Illinois.
*Owren, M. J. (2008, Aug). Vocal production processes involved in human laughter. Symposium on Production of Nonhuman Primate Vocalizations. XXIIth Congress of the International Society of Primatology, Edinburgh, Scotland.
Owren, M. J. (2009, Oct). Emotion and vocalization in mammalian perspective: What do we know, what do we need to know? Acoustical Society of America, San Antonio, TX.
Owren, M. J. (July, 2009). Sound Research for the Behavioral and Neural Sciences. A 2-day workshop presented to the Institute of Zoology, University of Veterninary Medicine Hannover, Germany.
Owren, Michael. Symposium organizer, “Emotion-related mechanisms of mammalian communication.” Acoustical Society of America, Oct 2009.
*Pai, A. Battle of the sexes: sexual conflict in the red flour beetle, Georgia Inst. of Technology, Atlanta, GA 2009.
Pai, A. R. Bass, T. Benning, J. Chu, A. Edlund, A. Griffin, P. Gunter-Smith, L. Hammonds-Odie, V. Ibeanusi, I. Imumorin, R. Jones, M. Lee, M. Maloney, G. McGinnis, J. Netherton, N. Woods, and C. Bauerle. Vision and Change in Biology Education Conference, Washington, DC, July 2009 .
*Pai, A., J. Bell, C. Richardson, K Adams, B. Bush. Opposites attract and likes repel: female mate choice in the red flour beetle. Animal Behavior Society Meeting, Snowbird, Utah, 2008.
*Pai, A., K Adams, J. Bell, C. Richardson, , B. Bush. Scent of danger: why female red flour beetles avoid male. Evolution conference, Moscow, Idaho, 2009.
Pai. A. Evolution in Action a case study based advanced Biology class at Spelman College. Fall case study conference, SUNY-Buffalo, Buffalo, NY 2008.
*Pan, W-J, G Thompson, M Magnuson, W Majeed, D Jaeger, S Keilholz. Investigating the Neural Basis of fMRI Resting-state Functional Connectivity Society for Neuroscience meeting, Chicago, 2009.
*Parent, M.B. (2009). A high fructose diet impairs hippocampal-dependent spatial water maze

retention performance. XXXIII Winter Conference on the Neurobiology of Learning and Memory, Park City, Utah.
Parent, M.B. Neuropsychological implications of insulin resistance 37th Annual Meeting of the International Neuropsychological Society, Atlanta, GA. (Feb. 2009).
Park, Edward S., Ashley E. Carson, Michael DiFeo, Thomas H. Barker, and Hang Lu, "Continuously- Perfused, Non-Cross-Contaminated Microfluidic Chamber Array for Cell Culture and Assay", BMES Annual Meeting, Pittsburg, PA, 2009
Park, Edward S., Ashley E. Carson, Michael DiFeo, Thomas H. Barker, and Hang Lu, "Microfluidic Chamber Array for Continuously-Perfused Cell Culture and Assay", AIChE Annual Meeting, Nashville, TN, 2009
Park, Edward S., Hang Lu, "A Microfluidic Migration Assay for Single-Cell Tracking in Well-Controlled and Non-Flowing Gradient Fields", AIChE Annual Meeting, Nashville, TN, 2009
Parr, L.A. Facial expression in nonhuman primates. AAAS, Chicago, IL, February 13, 2009.
Parr, L.A. Social cognition in nonhuman primates. The Biology of Social Cognition, Wellcome Trust Institute, Cambridge UK, August 11, 2009.
Partridge, Jenita, Corin White, Jonell Belle, A. Pai. Male mate preference in the confused flour beetle, Tribolium confusum. 8. Oral Presentation, South East Ecology and Evolution conference, Gainesville, Florida, 2009.
Paxton, R. & Hampton, R. R. (2009, March). Choice by mutual exclusivity in rhesus macaques (Macaca mulatta). International Conference on Comparative Cognition, Melbourne, FL.
Paxton, R. & Hampton, R.R. (2009, June). Tests of future planning in rhesus macaques (Macaca mulatta). The Primate Mind, Erice, Italy
*Pecore, J.L., Carruth, L.L., Hill, C., Demetrikopoulos, M.K., Zardetto-Smith,.A., & Frantz K.J. Methods to Maximize Student Engagement in Informal Science Education. Society for Neuroscience, Chicago, IL, Oct, 2009.
*Pecore, JL and LL Carruth. (2009). Supporting science reform efforts through professional development. Poster presented at the Association for Science Teacher Education Annual Conference, January 8-10, 2009. Hartford, CT.
Perdue, B., T. Stoinski, K.C. Gold, C.W. Kuhar, K.E.Lukas, T.L. Maple. A Longitudinal Assesment of Gorilla Personality. American Society of Primatologist meeting, 2009.
Perdue, B.M., Kelling, A.S., Snyder, R.J., Maple, T.L. (November 2009). Conducting Cognitive Research with Giant Pandas at Zoo Atlanta. Annual Conference of Chinese Committee of Breeding Technique for Giant Panda, Chengdu, China.
Povinelli DJ, Oswald T, Frey S, Preuss TM. 2008. Exquisite constraints on causal reasoning in chimpanzees. Annual Meeting of the James S McDonnell Foundation. Oxford, UK.
*Preuss TM, Cáceres M, Suwyn C, Oldham M, Mungall D, Geschwind DH, Thomas JW. 2009. Evolutionary reduction of beta-catenin (CTNNB1) expression in human frontal cortex. Soc Neuroscience meeting, Chicago, IL, 2009.
Price, M. & Anderson, P. (2008, November). Examining the effect of exposure therapies on post event processing in social anxiety using HLM. Poster presented at the 42nd annual meeting of the Association for the Advancement of Behavior and Cognitive Therapy. Orlando, FL, 2008.
Pulliam, John V.K. Transcription Factors Expressed in Rodent Models of Ischemic Stroke. National Center for Integrative Bioinformatics and Research Centers in Minority Institutions Workshop on Translational Bioinformatics, University of Michigan, Ann Arbor MI, 2009.
Pulliam, John V.K. Transcriptional Regulation of Ischemia-induced Gene Expression by Neuregulin-1 in Rat following Focal Stroke. New England Science Symposium, Harvard

Medical School Boston, MA, 2009.
Pulliam, John V.K., Greg D. Ford, Zhenfeng Xu & Byron D. Ford. Transcriptional Regulation of Ischemia-induced Gene Expression by Neuregulin-1 in Rat following Focal Stroke. Society for Neuroscience Conference, Chicago, IL, 2009.
Raper J., Stephens S., Goursaud A.-P.S., Wallen K., Bachevalier J. Neonatal lesions of the amygdala result in reduced fear behavior in male rhesus monkeys (Macaca mulatta) reared in a semi-naturalistic environment. Society for Neuroscience meeting, Washington DC, 2008.
Raper, J., Kazama, A.M., and Bachevalier, J. Blunted Fear Reactivity After Neonatal Amygdala and Orbital Frontal Lesions in Rhesus Monkeys. Proceedings of the Society of Neuroscience, 2009.
Raper, J., Wallen, K., and Bachevalier, J. Effects of Neonatal Amygdala Lesions on Emotional and Neuroendocrine Reactivity. Society of Behavioral Neuroendocrinology, 2009.
Ressler KJ, Jones SV, Davis M, Choi DC. Learning-dependent plasticity in the mouse olfactory system. Society for Neuroscience Annual Meeting, Washington, DC, 2008.
Ressler, K. Fear, Extinction and PTSD, Uniformed Services Annual Amygdala Conference, Bethesda, MD, April 2009.
Ressler, K. Gene and Environmental effects on fear and PTSD, Banbury Meeting, Cold Spring Harbor Labs, Winter 2009.
Ressler, K. Gene X Environment Interactions Mediating Anxiety Risk and Resilience, Anxiety Disorders Association of America, 2009 Scientific Symposium, New Mexico.
Ressler, K. Genes, Stress and Trauma: Interactions shaping vulnerability to psychopathology, 2009, International Society for Trauma Stress Studies, Atlanta, GA.
Ressler, K. Molecular Mechanisms of Fear: From Mice to Men, September 2009, Psychiatry Grand Rounds, Mount Sinai School of Medicine, NY, New York.
Ressler, K. Posttraumatic Stress Disorder: Disorder of Conditioned Fear, Non-extinction of Fear, Or Stress Responsiveness?, 2008 Pavlovian Society Meeting, New Jersey.
Ressler, K. The Biology of Incomplete Response and Non-Compliance in Mood Disorders, November 2008; International Forum on Mood and Anxiety Disorders; Vienna, Austria.
Ressler, K. The Emotional Brain: Integrating Knowledge across Basic Mechanisms, Genes and Neural Circuits and Translation into Novel Therapeutic Approaches for Anxiety and Depression. American College of Neuropharmacology, 2009.
*Ressler, Kerry, Seth Norrholm, Tanja Jovanovic, Nineequa Blanding, Elisabeth Binder, Rebekah Bradley, Erica Duncan. Conditioned Fear Inhibition and Civilian Trauma: Effects of Corticotropin- releasing Hormone Type 1 Receptor (CRHR1) Gene Polymorphisms; American College of Neuropsychopharmacology; Scottsdale, Arizona, 2008.
Ressler, Kerry: “Role of Cortical BDNF in Fear Expression in Transgenic Mice” December, 2008; American College of Neuropsychopharmacology; Phoenix, Arizona.
Richardson, C., J Belle, K. Adams, A. Pai. Observations on mating behavior of Tribolium castaneum. Poster Presentation, South East Ecology and Evolution conference, Gainesville, Florida, 2009.
*Rilling, James K. The arcuate fasciculus in humans, chimpanzees and macaques: implication for the evolution of language”. Neurobiology of human language and its evolution: Primate perspectives. 16th Annual Cognitive Neuroscience Society Meeting. San Francisco, CA. March 21-24, 2009.
Rilling, James K. The neural correlates of mate competition in dominant male rhesus macaques”. Evolutionary neurobiology of social hierarchies: Studies in humans, monkeys and rodents. 41st

annual meeting of the European Brain and Behavior Society. Rhodes, Greece. September 18, 2009.
*Rilling, James K. Comparative higher primate neuroimaging; Implications for the evolution of human brain and mind. Cognitive Sciences Brown Bag series at Georgia State University, 2009.
*Rilling, James K. Investigating the neural basis of cooperation and non-cooperation using fMRI and interactive games". George Washington University, 2009.
*Rilling, James K. Investigating the neural basis of cooperation and non-cooperation using fMRI and interactive games. Baylor College of Medicine, 2009.
*Rilling, James K. Social decision-making: neuroscientific and economic perspectives. Center for Mind, Brain and Culture (CMBC) lunch discussion series, 2009.
*Rilling, James K. The Neurobiology of Cooperation and Altruism: Context and the Evolution of Mechanisms for Solving Collective Action Problems. Indiana University, 2009.
*Rilling, James K. The Neurobiology of Cooperation and Altruism: Man the Hunted: Sociality, Altruism and Well-Being. Washington University, St. Louis, MO, 2009.
*Rilling, James K. The Neurobiology of Cooperation: Empathy and Compassion as Seen from the Perspective of Psychoanalysis. Emory University, 2009.
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