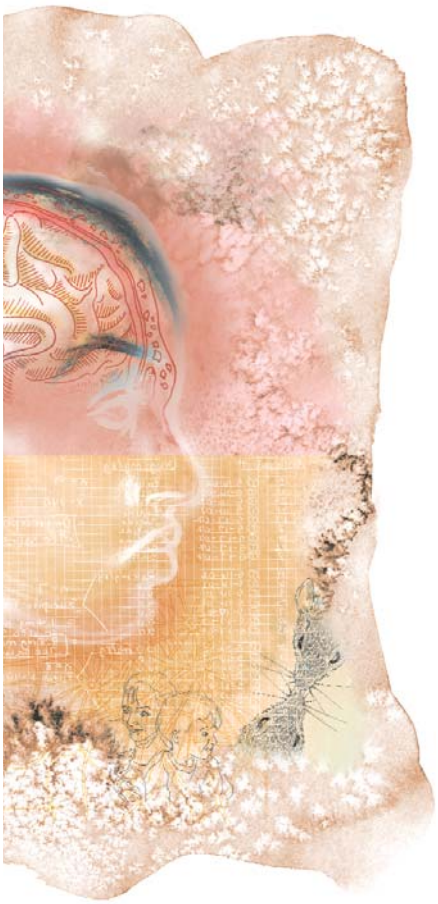

Center for Behavioral Neuroscience Annual Report

September 30, 2007

Program Year 8
Reporting from November 1, 2006
to October 31, 2007

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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

1a. Provide the following general information:

Date submitted	9/29/07
Reporting period	11/1/06 - 10/31/07
Name of Center	Center for Behavioral Neuroscience
Name of Center Director	H. Elliott Albers, Ph.D.
Lead University	GEORGIA STATE UNIVERSITY, PI: H. Elliott Albers, Ph.D.
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Email Address of Director	biohea@langate.gsu.edu
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: Tim Moore, Ph.D.
Address	223 James P. Brawley Dr., Atlanta, GA 30314
Phone Number	404-880-6939
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Role of Institution	Partner
Institution 3	EMORY UNIVERSITY, PI: Stuart Zola, Ph.D.
Address	954 Gatewood Rd. NE, Atlanta, GA 30329
Phone Number	404-727-7708
Fax Number	404-727-0623
Email Address of P.I.	szola@rmy.emory.edu
Role of Institution	Partner
Institution 4	GEORGIA INSTITUTE OF TECHNOLOGY, PI: Steve DeWeerth, Ph.D.
Address	301 Ferst Dr., Atlanta, GA 30332-5035
Phone Number	404-894-4738
Fax Number	404-385-5044
Email Address of P.I.	Steve.Deweerth@ece.gatech.edu
Role of Institution	Partner
Institution 5	MOREHOUSE COLLEGE, PI: J.K. Haynes, Ph.D.
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Phone Number	404-215-2610
Fax Number	404-507-8627
Email Address of P.I.	jhaynes@morehouse.edu
Role of Institution	Partner
Institution 6	MOREHOUSE SCHOOL OF MEDICINE, PI: Peter MacLeish, Ph.D.
Address	720 Westview DR. SW, Atlanta, GA 30310
Phone Number	404-756-5786
Fax Number	404-752-1078

Email Address of P.I.	macleip@msm.edu
Role of Institution	Partner
Institution 8	SPELMAN COLLEGE, PI: Michael McGinnis, Ph.D.
Address	350 Spelman Lane SW, Atlanta, GA 30314
Phone Number	404-270-5720
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Email Address of P.I.	gmcginni@spelman.edu
Role of Institution	Partner

1b. 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

I. 2. Executive Summary: The Executive Summary provides a brief overview of the vision, goals, plans, and performance and management indicators for the Center. Any significant changes from the original plans for the Center should be described. This section also reports on progress toward meeting the goals set for the Center (described in detail in the remaining sections) and provides an overview of significant accomplishments (one of the four pages should highlight these in nugget form) during the reporting period.

Our vision for the Center for Behavioral Neuroscience (CBN) is 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. As we progress in our mission, the CBN is becoming 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 upon which we continue to build stronger interdisciplinary and inter-institutional programs in behavioral neuroscience. The successful development and employment of collaboratories have provided a unique and powerful new approach to engaging in research and education in behavioral neuroscience. Also, the active partnerships in the center have resulted in curriculum changes and program improvements at the undergraduate and/or graduate level have occurred at all center institutions. Another major strength of the CBN is 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.

Despite these strengths of the Center, the structure and foci of the individual member institutions that make up the Center have to be maintained. Individual members within the Center often have to balance demands from several sources that can sometimes deter their participation in the Center's programs. Nonetheless, the opportunities presented by the multi-institutional approach to the Center's scientific and educational goals are beneficial to all participating members and we are striving to impart that sentiment among our institutional partners to enlist their support after NSF funding ends. For example, the Center's multi-institutional structure affords 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. Our graduate and postdoctoral training programs provide a unique breadth of training in various skills through our network of multiple mentors and training environments. This is only a sampling of the unique opportunities that would not exist without the Center.

Although the Center currently enjoys solid support from its institutional and individual members, as well as the NSF and the Georgia Research Alliance, our primary source of funding will cease in November of 2009. As a result, the leadership of the CBN continues to expend a large part of their efforts to obtain institutional and outside support for the CBN after this date. Thusfar, Georgia State University has agreed to support all CBN staff up to 50% of their current salary with full benefits in perpetuity. Failure to obtain similar support from Emory University, thusfar, has forced the CBN leaders to develop a new strategy for providing funding for the center's programs and administrative staff, most likely from outside our partner institutions. In order to better ensure the center's survival beyond 2009, it is almost certain that the CBN will over the next 2 years begin to change into a different form that it currently exists. The nature of the future CBN will depend in large part on the funding we are able to secure during that time period.

The following is a summary of the progress during the past funding cycle of the CBN. The CBN completed its eighth year of operation as of October 31, 2007. Our initial formal evaluations of our programs has provided ample data upon which to build the future of these programs and evaluation will be ongoing as long as the programs operate. These program evaluations are critical to our efforts toward obtaining funding from outside sources. In addition, through these evaluations we have identified aspects of our programs that can be improved or trimmed for better efficiency while maintaining quality.

Importantly, potential funding sources have been identified and strategies for approaches these sources for funding are being developed. We plan to begin approaching these sources this coming year through the submission of grants and personal appeals. If successful, these efforst will result in new funding that will alleviate some of the programmatic expenses as the NSF funds are decreased this next year.

A review of member participation and benefit from our research programs indicates that the Venture Grant program has provided enormous professional and financial benefit to participating members and their respective institutions. In contrast, although very valuable to some members of the CBN, the use of most of our technology cores has never reached the levels originally expected and we are still in the process of planning how to re-structure the cores for maximum benefit to the center in the future. The cores are, however, being used on a fee-for-service basis by many outside of the center. Therefore, it is conceivable that some, if not all, of the cores could be institutionalized in this manner.

The center's Graduate Scholars and Postdoctoral Fellowship program evaluations reflected the many benefits that these programs provide to the center members and the center's research and education missions. To date we have supported the education of 70 graduate students and 31 postdoctoral fellows with center resources, without which some may not have even applied to our partner institutions and many likely would not have had 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. Thus, their participation has been critical for the completion of many of the venture grants. In brief, over $2.5 million in venture grant and research participant support money awarded since 2000 has seeded new funding from other sources in an amount exceeding $80 million across our partner institutions. In addition, we report an impressive 299 professional publications and 426 professional presentations by Center members this year. Several of these papers and presentations have resulted from cross-laboratory and cross-institutional collaborations among center scientists, graduate students and postdocs.

In our efforts to increase overall student interest in studying behavioral neuroscience, the CBN continues to provide experiential education opportunities for students at all levels, provide science curriculum enhancement at the pre-college and undergraduate levels, and conduct proactive recruitment activities at the high school and undergraduate levels. The Center continues to promote behavioral neuroscience in K-12 curriculum in the local school systems 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. One of our primary programs is the CBN sponsored K-12 teacher-training workshop held each summer. Through these workshops we help teachers to develop neuroscience curricular materials that can be used in their own classes and by other teachers in Atlanta schools and in school systems nationwide. The Center's Lending Library of Learning Resources provides physical resources for use by K-12 science teachers in the local school systems and by our own center members who often visit local schools to teach about neuroscience. In addition, the Center supports hands-on science activities and exposure to research for K-12 students through Center activities and programs such as the Neuroscience Exposition, summer Brain Camps and the ION (Institute on Neuroscience) program. Our summer BRAIN research program for undergraduate students attracts 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 the career choices and/ or general interest in learning more about neuroscience of students who participate. Our assessment of these programs has provided critical data that we are using to seek other sources of funding for these programs.

The Center's Knowledge Transfer continues to focus primarily on enhancing public exposure to research and knowledge about social behavior from the field of behavioral neuroscience. One way to do this is to promote information about Center members and their research in public venues. In partnership

with the Fernbank Museum of Natural History, we continue to sponsor our successful "neuroscience in the movies" series on neuroscience themes including discussion of neuroscience themes as portrayed in the featured films. Our partnership with Zoo Atlanta has provided international exposure for the Center's educational and research programs through a our joint venture grant to enhance the Zoo's orangutan exhibit that includes a cognitive research component. The grand opening of this exhibit was picked up by dozens of news agencies around the world and was the topic of a CBS news brief. Importantly, these efforts not only provide local and national media exposure for the CBN, but also increase the visibility of the research we do in the public eye thereby educating the public about what we do and what we know. Our new partnership with Georgia Bio, a nonprofit organization whose mission is to bring more bioscience industry and workforce into Georgia, has resulted in the development and implementation of a new inter-institutional undergraduate course bridging business and life sciences taught by local bioscience industry CEOs. The CBN hopes to capitalize on these new relationships with local inductry to create undergraduate, graduate and postdoctoral internships in the local life sciences industry and to attract sponsorships for our educational and research programs

Diversity has been a major theme of the work of the CBN since its inception. From the beginning, the Center developed very specific goals in the area of diversity and continues to stand by those goals and to maintain its efforts to obtain them. Since the future of our funding remains uncertain, we have not had the leverage to recruit any new faculty members this year. Currently, our faculty membership is 11% minority and 39% female, above the national average in the latest ANDP report. Our postdoctoral fellowships go to support a group that is 12.5% minority and 63.5% female. Although the Center currently has no additional funds to allocate to new graduate student, as some of our senior students completed their degrees this past year, we were able to recruit a few additional graduate students into our Scholars program. Currently, our graduate scholars group is 13% minority and 77% female, also above the national average in the latest ANDP report. Moreover, 26 CBN graduate students have now completed their Ph.D.s, including 6 minorities and 17 females, and they have all gone on to postdoctoral training or teaching positions at a number of leading institutions. The Center continues to be successful at increasing the pool of undergraduate minority students pursuing graduate studies in neuroscience through increasing efforts to expose and attract undergraduate students to the Center's undergraduate research and educational programs. As in previous years, we accepted a high percentage of minority students into our undergraduate research program. In addition, this past year we partnered with our local Society for Neuroscience (SFN) chapter to provide travel awards to 32 undergraduate students to attend the annual SFN meeting here in Atlanta, Georgia. It is through these efforts that we have seen the greatest impact on the number of minorities and women choosing careers neuroscience.

In summary, a thorough review of all our programs indicates that we are meeting our long-term goals. Our strategic plan for the present year indictaes that we will exert additional efforts to wiritng grants and soliciting foundations and corporations through barious means to obtain funding for these programs and continue towards the ultimate goal of becoming a self-sustained center.

II. RESEARCH

1a and 1b. Describe the Center's overall research objectives, *if* they have changed since the previous reporting period. If the Center's overall research objectives changed, how did they change and why? Inform us of the <u>performance and management indicators</u> the Center has developed to assess progress in meeting its research objectives, if changed from the previous reporting period.

The research program of the CBN continues to be extremely productive based on a number of indicators. An analysis of publications by Center members indicates that the research output of the Center continues to increase substantially each year at all the member institutions (see Section VIII.1a). Furthermore, an analysis of our publications indicates that the interdisciplinary structure of the Center is working very well, as the number of collaborative publications has also been steadily increasing each year. Investigators continue to employ a variety of model systems and conceptual approaches on new projects each year and are currently employing cutting-edge technologies from advanced brain imaging to viral-vector methodology and genomic investigations into the very basic mechanisms and evolution of social behavior. The multidisciplinary nature of the Center's research is providing new insights to the field of behavioral neuroscience continues to open up new areas for investigation within the Center. Faculty at the smaller institutions continue to participate actively in collaboratory research as do numerous undergraduates from all participating institutions. The newest working groups in the areas of Memory and Cognition and Reward and Reinforcement, which cut across the traditional collaboratories have stimulated new interactions among CBN members. Our venture grant program supported new collaborative projects and new investigators in these cross-cutting areas along with those in our traditional collaboratories (See Section IX, Indirect/Other Outputs). Importantly, venture grant funding continues to be instrumental in the generation of pilot data that have then been leveraged into other support from national granting agencies (see Section IX, Indirect/Other Outputs). 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 technology. Some of our Postdoctoral Fellows have been PIs on venture grants and some of these projects have been the basis of successful applications for National Research Service Awards for the postdoctoral associates. Our postdocs and graduate students are now graduating into successful positions elsewhere (see section VIII, Center-wide Outputs). Numerous undergraduate students from each of our member institutions have been involved in the research projects described below. Finally, many new research articles have been published in top-notch journals such as **Nature**, **Science, Journal of Neuroscience**, and **Nature Neuroscience** (see Section VIII, Center-wide Outputs). In summary, most of our research objectives are clearly being met.

Recent efforts to seek and obtain funding for these programs have not yet resulted in new funding sources for our research programs. However, these efforts are still ongoing and include training grants to NSF and NIH for our graduate and postdoctoral training programs, a solicition from the Templeton Foundation to our center for possible funding to conduct research on "positive emotions", and, most importantly, the continued efforts to institutionalize our research programs through support from our partner institutions.

1c. Discuss any problems you have encountered in making progress toward the center's research goals during the reporting period as well as any problems anticipated in the next period. Include your plans for addressing these problems.

There have been no significant problems in meeting our research goals encountered during the reporting period. We do not foresee any significant problems in the next period in achieving the CBN's goals of advancing knowledge about the basic neural and hormonal mechanisms of social behavior. However, the Center has encountered the problem of maintaining support for our research activities as NSF funding ramps down over the next two years. The Center is actively pursuing several options for acquiring such support.

A major thrust has been to develop plans to supplant a significant portion of CBN's current support with institutional commitment from the member universities and colleges. Our efforts at Georgia State University have already been successful through a commitment for staff salary support for the CBN

specifically and the establishment of the GSU "Brains and Behavior Program," which emulates CBN's structure of venture grants and graduate student support for neuroscientists (and others) across campus, including one division that is essentially CBN members at GSU. We have begun to see a similar impact at Ga. Tech. Early on, CBN seeded a large computational neuroscience center at Ga. Tech. Which is now fully funded and supported by other grants. More recently, the addition of a new cognitive psychology training program promises to have overlap with CBN research and training, although it is unclear whether this will result in financial support that will directly impact the CBN. Although our efforts have expanded the behavioral neuroscience graduate training at Emory, our efforts to obtain institutional support from Emory University have not met with success so far. With new leadership at Emory, we have begun meetings with these leaders to enducate them about the center and how it has benefited Emory's research and education mission over the past either years. We hope that the new leadership at Emory will be more inclined to provide financial support on some level within the next year. The addition of two more behavioral neuroscientists at Morehouse School of Medicine in the past year has put MSM in the position of being able to begin a viable training program in neuroscience. Therefore, for the most part, we expect that most of the graduate and postdoctoral training and faculty research efforts will be or have been already institutionalized to varying degrees. Nonetheless, funding to support graduate students and postdocs that specifically work on collaborative projects across CBN faculty labs would help maintain the multi-institutional character of the CBN. Most importantly, we believe that the center's Venture Grant program, which seems to play a key role in seeding the center's collaborative research efforts, must be funded in some manner to continue to motivate new, innovative research collaborations among center members. Our challenge remains incorporating our smaller college partners into these initiatives. Even though all have expressed moral support for maintaining the CBN post-NSF funding, it is unclear whether these institutions will be in a position to provide any substantial financial support for the future of the CBN.

In parallel with these institution-based initiatives, we are in discussion with some foundations, non-profits, and corporations, and preparing collaborative grants that may result in funds that could help sustain the CBN. We have obtained a continuing verbal commitment from the Georgia Research Alliance, the state program for support of higher education, to provide equipment and renovation funds for CBN faculty at member institutions in order to continue the Center's mission of upgrading our participants' research infrastructure and increasing neuroscience faculty through support for new hires. Nonetheless, financial commitments from these efforts have yet to be obtained.

2a and 2b. Briefly describe the research thrust areas at the Center. Please provide basic information for each thrust area and details of significant accomplishments during the reporting period, including any research partnerships and their contributions to the Center (*do not include publications, presentations, etc., that are reported in Section VIII, Center-wide Outputs and Issues).* Include in the narrative a discussion of the goals, activities, and outcomes and/or impacts in the current reporting period, if changed from the previous reporting period. Be sure to discuss how the activities in the various research thrust areas enable the Center to meet its goals.

What follows is a brief discussion of selected research projects from each of the four traditional collaboratories. It was our goal to give an overview of the variety of the research that has grown out of the CBN. Many, if not most, of these collaborations would not have happened had it not been for the CBN.

i. Affiliation Collaboratory

The **Affiliation Collaboratory** has made progress in several research areas in the past year. The information provided below represents some of the major areas of investigation and progress. A particular highlight this year is the progress in describing the genetic basis of species differences in affiliation and

social bonding and the evolution of species differences, a project that involved a collaboration with Emory faculty and our partners at the Atlanta Zoo as well as participating researchers and students at Spelman College and Morehouse College. There are a large number of projects and collaborations within the collaboratory across CBN institutions and developing international collaborations as well. The following highlights only a few of these projects. Space limitations do not allow a complete description of all projects ongoing in the collaboratory.

Developing Genomic Resources for Prairie vole. (McGraw, Young, Thomas) In an effort to maximize the utility of the prairie vole system for identifying genes involved in the regulation of affiliative behavior, Lisa McGraw (CBN Post-doc), Dr. Larry Young and James Thomas have launched an initiative to develop genomic resources for the prairie vole. They have already created a microsatellite library that is currently being used to generate a genome-wide set of polymorphic microsatellite markers that can be used in quantitative trait locus (QTL) studies to identify novel genes underlying natural variation in affiliative behaviors. This resource will be made available to all vole researchers. In addition, we have initiated selective breeding that is designed to create lines of voles with high or low levels of social bonding. Once these lines are established, the microsatellite markers will then be used to identify genes contributing to the line differences in social bonding behavior. Dr. Young has received a grant from Autism Speaks to fund this project. In addition, Drs. Young, Thomas and McGraw have submitted an R21 to NIH to support aspects of this project as well as to create BAC libraries for the voles. BAC libraries will facilitate cloning of any gene in the prairie vole and will be made available to all researchers.

Evolution of the primate vasopressin receptor promoter. (Young, Donaldson, Stoinski) In a collaboration between Dr. Young and Tara Soinski (Zoo Atlanta), and Yerkes National Primate Research Center, we have continued to examine the evolution of the promoter of the primate vasopressin receptor (*avpr1a*). Previous work in voles demonstrated that variation in a repetitive microsatellite element in the promoter of the *avpr1a* is associated with variation in social behavior, including pair bonding. Several human genetic studies have now demonstrated associations between allele variants in these microsatellites and various social behaviors, including in autism. We have now analyzed the microsatellite element in more than a dozen primate species, including lemurs, bush babies, several monkeys, and the apes. The results do not reveal a simple relationship between microsatellite length and mating system, but do confirm that this region has rapidly evolved during primate evolution, which may have important implications the evolution of social behavior. Perhaps the most exciting finding is the presence of polymorphisms in chimpanzee populations. Humans and Bonobos have a tandem repeat of two ~350 bp microsatellite-containing elements in the *avpr1a* promoter. All monkeys have a single repeat element. Interestingly, both single and duplicated alleles are present in chimpanzee (*Pan troglodytes*) populations with allele frequencies of 0.795 and 0.205 for the single and duplicated alleles, respectively, based on the analysis of 44 wild-caught individuals. Studies are currently underway to investigate the hypothesis that this region has undergone a selective sweep and may represent a candidate region for contributing to individual variation in sociobehavioral traits in chimpanzees. Future studies will investigate the behavioral implications of this variation. In collaboration with Dr. Todd Preuss, Dr. Young has begun to compare vasopressin receptor expression in human and chimpanzees and future studies will determine whether the polymorphism influences gene expression patterns.

Neural Systems of Communication. (Rilling, Preuss, Parr, Liu) Communication is an essential element of affiliative behaviors. Two groups within the Affiliation collaboratory have been investigating the neural systems involved in communications. One group (Rilling, Preuss, Parr) have used comparative diffusion tensor imaging (DTI) to map the circuits and connections that are involved in human communication. Compared to the human pathway, the chimpanzee pathway is smaller relative to brain size and weaker

relative to completing fiber tracts. In macaques, they observe very weak connections between cortical regions homologous to human language centers, suggesting that this pathway has evolved with the emergence of complex communication.

Robert Liu, a new CBN faculty, has made some exciting discoveries regarding plasticity in the auditory pathways in mice involved in processing pup vocalizations. The main finding is that the neural response to mouse pup ultrasonic distress calls is improved in mouse mothers compared to pup-naive virgins in such a way that the information conveyed by the responses for detecting and discriminating pup calls is better. To our knowledge, this is the first demonstration of cortical plasticity in a natural acoustic communication context. This study was reported on in several press reports.

Consequences of Early-life Attachment and Neglect. (Young, Plotsky, Sanchez, McCormack, Heim) Several important discoveries have been made in relation to the effects of early-life attachment and neglect on brain systems and behavior. Early-life nurturing (e.g. parental contact and licking and grooming) are thought to have long-term effects of adult behavior which are mediated by oxytocin. Young and Plotsky in collaboration with Karen Bales (UC Irvine) and Sue Carter (Univ. Illinois, Chicago) found that neonatal infusions of oxytocin result in altered expression of vasopressin receptors in the adult male prairie vole brain. This provides a potential mechanism by which early life nurturing (or lack thereof) affects later-life social behaviors.

Drs. Sanchez and McCormack have continued to explore the effects of early-life neglect in rhesus macaques. Infant rhesus monkeys that experienced physical abuse, co-morbid with high levels of rejection by their mothers, exhibit alterations in normal socio-emotional development, growing up exhibiting behavioral signs of distress/irritability (high rates of tantrums and screams) and delayed social development (delayed independence from mom, as well as less exploration and play). Interestingly, this behavioral profile is consistent with alterations previously reported in maltreated human children. The infants also exhibited alterations in monoamine neurotransmitter systems (in particular, low levels of serotonergic activity, indexed by low CSF levels of 5-HIAA). Sanchez and colleagues have characterized the impact of physical abuse and high maternal rejection on the immune function of the animals, detecting a strong association between maternal abuse and rejection experienced as infants and increased levels of inflammatory markers (MAPK p-p38), which is of significant relevance because it links early adverse stress with somatic disorders that develop later in life, in addition to psychopathology. Stress results in activation of innate immune responses including release of proinflammatory cytokines. Activation (phosphorylation) of the p38 MAPK signaling cascade by cytokines increases the activity of the 5-HT transporter. Sanchez investigated the relationship between the activation of inflammatory signaling pathways and brain 5-HT function in juvenile macaques maltreated as infants. Increased p38 activity was associated with decreased 5-HIAA in CSF and increased maternal rejection. These data provide the first evidence of an *in vivo* relationship between activation of p38 MAPK signaling pathways and brain 5-HT function in an animal model of early-life stress and indicate that activation of inflammatory signaling may participate in the contribution of early-life stress to psychiatric morbidity.

Dr. Heim, Dr. Young and colleagues in the Dept. of Psychiatry at Emory have examined the effects of early-life neglect in humans on brain oxytocin systems. Their study found that women who experience early-life physical, emotion, or sexual maltreatment have significantly lower oxytocin in the CSF compared to controls. This study has been submitted to the American Journal of Psychiatry.

Disruption of Social Bonds in Adults. (Young, Ahern). Dr. Young, Todd Ahern (CBN student) and colleagues in Germany (Bosch and Neumann) have been using the monogamous prairie vole to investigate the behavioral and physiological effects of social loss. Prairie vole males that loss a partner display depressive-like behavior. This change in behavior is associated with an increase in corticotrophin

releasing factor (CRF) in the brain. In the last year, this group demonstrated that both CRF type 1 and type 2 receptors mediate this behavioral change. This manuscript has been submitted to Journal of Neuroscience and Dr. Young has submitted an R01 to NIH based on these data.

ii. Aggression Collaboratory

Over the course of CBN funding, the research of the **Aggression Collaboratory** has been focused on the neural and behavioral mechanisms that underlie the perception and formation of dominance hierarchies and the subsequent effects of social status on the structure and function of the central nervous system. The research has been and continues to be strongly comparative, using six disparate animal models: monkeys, Syrian hamsters, rats, cichlid fish, anolis lizards, crayfish and termites. New discussions have begun regarding projects involving an exploration of genetic polymorphisms underlying aggressive phenotypes in humans. All seven models use aggression to garner resources during interactions with conspecifics, and all form dominance hierarchies of some kind based on the outcome of initial agonistic interactions. In several models including humans, the experience of social defeat has been shown to have profound and long-lasting effects on brain and behavior. These similar patterns of aggressive and submissive behavior occur despite extensive differences in the animals' brains, behavior, and ecological niches. This led collaboratory members to ask whether these behaviors are subserved by a common set of physiological mechanisms. Investigators are using these models to address the following: (a) what are the key behaviors associated with dominance hierarchy formation and maintenance?; (b) what are the brain areas and circuits that are involved?; (c) what are the neurochemical signals that are released or that gate these behaviors?; (d) what triggers their release, what is the pattern of release, and how does that pattern change?; (e) what changes occur in the effect of these chemicals on their targets in response to a change in social status?; (f) how do changes in the receptors or their pattern of expression account for the change in a neurochemical effect or in social behavior?; and (g) how do social species learn about dominance hierarchies? It is important to note that the aggression collaboratory focuses on both the dominant and the submissive behaviors emitted by organisms in social conflict situations; thus, we are investigating the full range of agonistic behaviors, not just aggressive behavior. As such, new collaborations with researchers in the Memory and Cognition Collaboratory have begun, investigating the cognitive processes underlying assessment of social rank in complex nonhuman primate social groups. In addition, new international collaborations are developing to target the determinants of aggression in human populations. Progress on key projects is summarized below.

An ethological approach to cognition in monkeys: Inference of social rank. (Hampton, Wilson, Fischer). This project is beginning its third year and is part of our cross-collaboratory project involving the Aggression and Reproduction collaboratories as well as the Behavioral Technology Core. A venture grant has supported this project, and has served as a catalyst for getting two related projects on social cognition started in the Hampton lab. They have examined whether rhesus macaques can recognize familiar monkeys filmed in video clips, using a forced-five-choice delayed video-to-picture matching-to-sample procedure. Five second video clips of familiar monkeys were presented as a sample, followed by five still images as comparisons. All six subjects learned to identify monkeys from the video clips and to generalize performance to new video clips on the first trial. After this training, they examined the monkeys performance with video clips taken from a substantially different view from that used in training. Four out of five subjects tested successfully selected the correct picture significantly above chance level. These results indicate that the subjects identify the monkeys in the video clips and demonstrate the feasibility of using video stimuli in a variety of studies of social cognition in rhesus monkeys. Following these results, the Hampton lab has asked two questions. 1) Can monkeys recognize dominance relationships based on behavioral cues? 2) Can they form a mental representation of a dominance hierarchy from viewing video

scenes of a set of monkeys interacting socially? In order to rule out use of non-behavioral cues such as body size, they created a set of video clips of artificial social interactions using video editing software. In these videos, one monkey demonstrated dominance over another. Together the set of videos represented an artificial linear dominance hierarchy consisting of five stimulus monkeys. Subjects rapidly learned to pick the dominant monkey in each video clip, further demonstrating the feasibility of using videos of complex social interactions as stimuli in cognitive experiments. Three of six monkeys successfully generalized their performance to new monkeys in a new context. In additional testing, they also showed that monkeys can remember the identity and relative dominance of monkeys seen in videos and can correctly identify the dominant of two familiar monkeys without the benefit of behavioral cues. Further analyses revealed that relative rank of stimulus monkeys affected subjects' performance in accuracy and latency. Monkeys performed more accurately and more quickly when the "gap" in dominance was large. This effect suggests that subjects placed stimulus monkeys into a linear representation. This demonstrates that monkeys can indeed form a mental representation of a dominance hierarchy based on experience with our artificial social interaction videos.

Molecular basis of social learning after social defeat in hamsters. (Huhman, Ressler, Albers, Markham, Lin, Stanek). Two collaborations between the Huhman and Ressler (Emory Neuroscience/ Psychiatry) laboratories and the Albers laboratory (GSU Psychology and Biology) are examining the molecular basis of the learning that occurs when hamsters experience social defeat. The first project is exploring the role of neurotrophic factors in the acquisition of conditioned defeat. The data indicate that brain derived neurotrophic factor is significantly different between dominant and subordinate hamsters in brain areas including subnuclei of the amygdala. Blocking neurotropin receptors in the amygdala also blocks the behavioral changes associated with social defeat. The second project, funded by a Venture grant, is using the Molecular Core in association with Byron Ford at Morehouse School of Medicine to use gene array tools to compare the brains of dominant and subordinate hamsters following social conflict. Gene arrays are currently being completed on punches of tissue from hamster amygdala, a brain area that the Huhman lab has shown to be critical in the formation of behavioral changes that occur in response to social defeat.

V1a receptors, sex, aggression and photoperiod in hamsters. (Gutzler, Albers). Two projects are underway. The first has revealed that a selective V1aR antagonist microinjected into the AH alters the expression of aggression on the first day of diestrous (D1) in female hamsters. The selective V1aR antagonist, Manning compound stimulated aggressive behavior (i.e., a decrease in the latency to attack, increase in aggressive duration, and an increase in the number of attacks) in a dose-dependent manner. Because the V1aR antagonist stimulates aggression, they hypothesized that on the day of behavioral estrus an injection of the antagonist would also stimulate aggression and reduce or eliminate the lordosis reflex, but this was not the case as the animals showed normal lordosis behavior. These data suggest that activation of the V1aR in the AH inhibits aggression but does not alter sexual behavior. Furthermore, the effects of injecting the V1aR antagonist in the AH seem to be specific to aggression and flank marking behavior, but not sexual behavior.

The second project examines whether there are seasonal changes in V1aR binding in subregions of the limbic system in female hamsters housed in short (SD) or long (LD) photoperiods for 10 weeks. V1aR autoradiography revealed that V1aR binding in the anterointermediate portion of the bed nucleus of the stria terminalis (BNST) was significantly greater in females housed in LD than in those housed in SD. In the posterior-medial portion of the BNST, LD females had significantly lower V1aR binding densities compared to SD females. In the anterior medial preoptic area (MPOA), we observed significantly higher V1aR binding in females housed in LD than in SD. The opposite relationship was found in the posterior

portion of the MPOA, where SD females had greater V1aR binding than LD females. In the anterior portion of the AH, LD females had significantly greater V1aR binding as compared to SD. In contrast, the posterior portion of this area did not show any photoperiod-dependent differences. These data indicate that photoperiod influences V1aR binding within subregions of the brain areas critical for the expression of many social behaviors, including aggression. These seasonal changes in V1aR binding may underlie some of the dramatic seasonal changes that occur in the expression of many social behaviors.

Agonistic behavior in crayfish. (Derby, Edwards, Horner, Herberholz, Song) Several crayfish species establish social dominance hierarchies through agonistic interactions. Chemical signals are known to play an important role in these interactions by regulating the dynamics of fighting behavior and facilitating social status recognition. However, the specific parts of the chemosensory system involved in detecting these signals are not known. The primary olfactory organ in crayfish and other decapod crustaceans is the first pair of antennae (antennules). Decapod antennules contain multiple, anatomically separate chemosensory pathways. The two main pathways (the aesthetasc/ olfactory lobe pathway and the non aesthetasc/ lateral antennular neuropil pathway) originate in different populations of antennular sensilla and project to different neuropils in the brain. Several studies have demonstrated that the aesthetasc pathway plays a critical role in various crustacean social and sexual behaviors. This project examines whether this pathway also plays an important role in mediating agonistic behavior in crayfish. The fighting behavior of pairs of size matched male crayfish (*Procambarus clarkii*) was observed over the course of three trial days. The importance of the aesthetasc/olfactory lobe pathway was assessed by selectively ablating the aesthetasc sensilla from the antennules of six pairs of crayfish and comparing the behavior of these ablated pairs to that of intact controls. Results show that the amount of fighting between control (unablated) crayfish pairs decreased significantly over repeated pairings whereas the amount of fighting between aesthetasc ablated pairs was unchanged. Thus, the aesthetasc pathway regulates some aspects of agonstic behavior, presumably by mediating chemical communication between the combatants.

Chemical communication and aggression in termites. (Jackson, Goodisman, Williams, Snow, Morris). The goal of this project (which is supported by a newly funded venture grant) is to look for genetic correlates of aggression in termites and to determine if aggressive behavior is associated with genetic dissimilarity at the colony level using behavioral assays, DNA microsatellite markers and gene expression techniques. Behavioral and genetic assays are also being used as basis for teaching modules at Morehouse College and the University of Florida. This project has first developed a new quantitative measure of aggression for termites at the colonial level. The method consists of having live ant tarsi attached to small cardboard squares and placed in a petri dish (9 cm). Workers with or without soldier termites are added to the petri dish and observed for 30 minutes. A variety of measures are then made (for example, number of lunges and bites aimed at the ant by workers and soldiers). They have then taken these same measures when termites are confronting free moving ants. There are clear differences between colonies in terms of level of aggression and this will form the basis of the genetic studies.

In addition, early work in the Jackson lab has shown that when termites are given a choice among filter paper saturated with termite contact pheromone, ant pheromone, hexane or clean filter paper, the termites are attracted to termite, ant, hexane and clean filter paper in that order. In contrast, ants were attracted to ant, clean, hexane and termite paper. This year we have increased sample size and video recorded the experiment and we are getting basically same results.

Neurotropin expression in anolis lizards (*Anolis carolinensis*). (Wilczynski, Black, Ressler). When paired together, male anoles interact with ritual displays and fighting, ultimately forming a dominant-

subordinate dyad. Previous work from the Wilczynski lab found that dominant and subordinate males thereafter differ significantly in several ways, including aggressive tendencies and stress tolerance. The investigators are now investigating the roles of two neurotropins, BDNF and NGF, in the forebrain changes associated with social status changes. These researchers have developed *in situ* hybridization probes for both neurotropins as well as their receptor (the TrkB receptor) have mapped out patterns of BDNF expression. In addition, preliminary results indicate that BDNF is upregulated in dominants compared to their subordinate social partners in the amygdala, while BDNF expression remains similar in the medial pallium (hippocampus) of both. This work indicates that differential expression of neurotropins in the limbic nuclei of dominant vs. subordinate male anoles contributes to the neural changes that occur when aggression leads to social dominance. In collaboration with the Cellular (Viral Vector) core, viral vectors are being developed for use in reptiles to experimentally manipulate the expression of neurotropins and their receptors. Preliminary work on the development of the viral vectors are very promising, suggesting successful transfection with a lentavirus-based vector.

Seasonally and socially modulated adult brain cell proliferation in the green treefrog (*Hyla cinerea*). (Wilczynski, Almli). Amphibians maintain the capacity for substantial neuro- and glio-genesis throughout life. Cell proliferation in the forebrain is expecially abundant in adult frogs. In a project that cuts across the Aggression and Reproduction Collaboratories, these investigators used BrdU immunocytochemistry to assess the effects of social stimulation on cell proliferation. Adult males were exposed to conspecific vocal signals (male advertisement calls) nightly for 10 consecutive days, mimicking the natural acoustic experience of males in a mating chorus in which they interact vocally with other males. Compared to control males hearing tones or no stimuli, males stimulated with conspecific vocal signals had significantly more cell proliferation in the preoptic area and ventral hypothalamus. Furthermore, there was a seasonal pattern overlaying the social modulation: as the natural breeding season progresses from June to September, there is a seasonal decline in cell proliferation in all groups. Moreover, the effects of social stimulation were greatest at the height of the breeding season when cell proliferation was naturally greatest. These results indicate that male-male vocal interactions during the breeding season can increase cell proliferation in forebrain regions crucial for regulating reproductive physiology and behavior.

Potential human projects in the aggression collaboratory. We recently held a collaboratory meeting in which two projects were presented to the collaboratory for our input into planning some future experiments relevant to aggression. The first project (Klevens, Heim) involves a population in Medellin, Columbia wherein children are exposed to very high levels of aggression at a very early age. These children then begin to show abnormally high levels of aggression and externalizing behavior by age 3. The hope is to begin to examine some neurobiological concomitants (i.e., genes, hormones). Discussions will continue this year. The second project (Waldman) is to examine the association of a variety of candidate genes from the catecholaminergic and vasopressinergic systems with aggression-related phenotypes in children. Both of these projects have stimulated interesting discussion in which all parties have learned a considerable amount and represent a potential arena for novel collaborations among CBN members.

iii. Fear Collaboratory

A large number of projects have been completed or are ongoing in the **Fear Collaboratory.** This collaboratory continues to be supported by a large number of venture grants that support collaborations among CBN faculty and labs, as well as participate in collaborations with other collaboratories and with the cores. Projects undertaken by the **Fear Collaboratory** are summarized below. Some of these projects

were supported in part by CBN Venture Grants, while many others resulted from projects funded independently from grants based on previous CBN support or took advantage of other CBN support or technical cores to generate novel research projects.

siRNA lentiviral constructs to modify GABAergic transmission in the amygdala (Heldt, Ressler). Work is continues to examine the potential to effectively use siRNA lentiviral constructs to modify GABAergic transmission in the amygdala. Our dsRNA in vivo experiments have shown effective knockdown of alpha2 and alpha5 GABA(A)subunit proteins as well as GAD67 protein, but have yet to convincingly demonstrate in vivo knockdown with current analytical tools .Currently we are in the process of employing rtPCR to examine in vivo knockdown and producing siRNA-LV vectors under DOX-mediated temporal control for future knockdown studies. Recent work has also examined the behavioral phenotype of D1 and D5 KO mice. Initial studies have revealed an acquisition of fear deficit in D1 KOs, but no fear retention deficit. In addition, D1 KOs show a deficit in startle habituation and prepulse inhibition, surprisingly unreported in existing literature. We have also recently found that regional lentiviral-mediated knockdown of alpha1 in the hippocampus produces a decrease in the amnesic effects of Zolpidem, a BZ-like agonist, on the acquisition of contextual fear in mice. We will soon examine whether the decreased amnesia is also observed with other drugs (e.g. diazepam) and other conditions (e.g. auditory-cue fear). Soon to be finished are a number of studies examining the effects of GR205171, a NK1 antagonist, on the expression of fear/anxiety in Mongolian gerbils as measured by the elevated plus-maze and contextual FPS.

Differential BDNF expression in primary and associative olfactory areas with odor-cued fear learning (Jones, Davis, Ressler). Brain-derived neurotrophic factor (BDNF) is involved in memory formation in the hippocampus and amygdala, but little is known about its role in adult sensory systems during learning. Here, we examined BDNF mRNA expression two hours following fear-conditioning across multiple areas from primary to associative, including the mitral cell layer of the olfactory bulb (OB), anterior piriform cortex (APC), posterior piriform cortex (PPC), and basolateral amygdala (BLA). In two separate experiments, adult male mice received ten pairings of amyl acetate with footshock (paired group), or the same number of unpaired odors and shocks (unpaired group). We found increased BDNF mRNA relative to homecage controls within all areas in the paired group, including the associative PPC and BLA. In the unpaired group and odor alone group, BDNF mRNA significantly increased relative to homecage in the primary olfactory areas – the OB and APC only. Additionally, we found significant correlations between BDNF mRNA expression and fear expression in the PPC and BLA but not OB or APC. These results are consistent with a model in which OB and APC respond and express plasticity-related genes with any olfactory stimulation. In contrast, the PPC and BLA respond and express increased BDNF levels only when associative information is integrated.

Amygdala-specific deletion of alpha1-containing GABA(A) receptors disrupts the sedative and anticonvulsant effects of the selective a1 agonist zolpidem. (Heldt, Ressler). Pharmacological studies using ligands partially selective for various GABA(A) receptor subtypes indicate that the anticonvulsant and sedative actions of benzodiazepines (BZ) are in part mediated by a1-GABA(A) receptors. These pharmacological features have been supported by recent studies using transgenic mouse lines which possess mutations in the a1-GABA(A) receptor subtype. However, the degree to which these BZ actions are mediated by distinct brain regions is presently unknown. In the current study we examined the sedative and anticonvulsant effects of BZ as well as baseline behaviors in mice lacking a1-GABA(A) receptors in the amygdala using a1-GABA(A) *inducible* knockout mice. These mice possess *loxP* sites on both side of an a1

exon encoding an essential transmembrane domain which can be deleted in the presence of Cre recombinase (CRE). To induce CRE-mediated gene deletion in a localized fashion, a1-GABA(A) inducible mice received bilateral microinjections of either CRE- producing lentivirus or a control lentivirus that does not produce CRE (a GFP-producing lentivirus). The sedative effect of the selective a1 agonist, zolpidem was measured by examining the total motor activity counts during the 30-min open-field test session. Open-field test results indicated that the motor activity in a1-KO mice was significantly higher than GFP-control mice after zolpidem injections, suggesting a blunted sedative effective of zolpidem in a1-KO mice. The anticonvulsant effects of zolpidem were examined by systemic administration of the zolpidem followed 15min latter by the administration of the chemoconvulsant pentylenetetrazol (PTZ). When compared to GFP control mice, the latency for clonic-tonic seizures was significantly reduced in amygdala-specific a1-KO mice, indicating a decrease in the anticonvulsant effects of zolpidem. In addition, the mortality rate of amygdala-specific a1-KO mice was reliably higher than control mice. Posttest evaluations of a1- and a2-GABA(A) levels of mRNA via *in situ* hybridization suggested a discriminate, selective knockout of a1-containing GABA(A) receptors in the amygdala. Together these finding suggest that the anticonvulsant and sedative actions of BZ are in part mediated by a1-GABA(A) receptors located within the amygdala.

β-catenin is required for the consolidation of fear memories in adult mice (Maguschak, Ressler). Although it was initially identified for its role in development, β-catenin is expressed broadly in the adult mammalian brain and is implicated in neuronal synapse regulation and plasticity. Several lines of evidence suggest that β-catenin plays a critical function in the synaptic remodeling underlying new memory formation; however, because knockouts of β-catenin are embryonic lethal, there have been no studies on the role of this protein in standard behavioral learning and memory assays. In the present study, we examined the role of β-catenin in amygdala-dependent learning. We first demonstrated that β-catenin phosphorylation levels change in a temporally specific way during the initial period of memory formation (consolidation) following the acquisition of conditioned fear. To examine the effect of manipulating the β-catenin gene, we used a lentiviral vector which expresses Cre recombinase in combination with a β-catenin inducible mutant mouse (in which the β-catenin gene is flanked by loxP sequences) to create regional and temporal specific deletions of β-catenin in adult mice. Animals were then tested in a variety of behavioral paradigms. Our results suggest that amygdala-specific β-catenin deletions do not affect baseline anxiety and activity behavior. In addition, there were no deficits in the acquisition of conditioned fear, suggesting that amygdala baseline function was intact and that the animals were able to encode and express fear memory. Upon later testing, however, we found that animals with amygdala-specific β-catenin deletions prior to training did not retain long-term memory of the conditioned fear. Thus it appears that the β-catenin deletion prevented the consolidation of conditioned fear as measured by both freezing and fear-potentiated startle. These data demonstrate that β-catenin within the amygdala is required for the consolidation, but not acquisition, of fear memory. Furthermore, this suggests a general role for β-catenin in learning and memory in adults in addition to its previously defined role in development.

Construction of cell-type specific promoter lentiviruses for optically guiding electrophysiological recordings of distinct interneuron populations within the basolateral amygdala of rats. (Jasnow, Maguschak, Hammack, Chhatwal, Ressler, Rainnie). A growing body of evidence suggests that aberrant activity of neurons in the basolateral amygdala (BLA) plays a critical role in the etiology of many psychiatric disorders. Two principle cell types are found in the BLA; 1) glutamatergic projections neurons (PNs), and 2) GABAergic inhibitory interneurons (INs). While the physiological properties of BLA PNs have been well documented, little is known about the physiological properties of BLA INs. In general,

BLA INs can be subdivided into 4 subtypes based on their immunocytochemical profiles. Namely, 1) Parvalbumin (PV) immunoreactive interneurons that represent ~40% of the total population, 2) somatostatin-(SST) containing interneurons which make up 20% of the population,3) cholecystokinin-(CCK) containing neurons which also represent 20% of the total population, and 4) vasoactive intestinal peptide-(VIP) containing interneurons, which also represent 20% of the population. Data from our lab and others suggests that there are functional differences among the interneuron sub populations. In order to more completely understand the BLA network and how it processes emotionally salient sensory input, it is necessary to understand the physiological and functional properties of the interneurons within this region. However, it is impossible to *a priori* identify the different IN subtypes in an *in vitro* slice preparation from rat BLA. To circumvent this, we have developed cell-type specific lentiviral vectors expressing GFP based on the promoter region of the four distinct interneuron populations within the BLA. We have demonstrated that the CCK-promoter lentivirus is specifically expressed in CCK interneurons within the BLA and have identified three distinct subtypes of CCK neurons based on their physiological properties. Currently, we are validating the *in vivo* specificity of the PV, SST and VIP promoter specific viruses. These data demonstrate the utility of cell-type specific lentiviruses for optically guiding electrophysiological recordings of specific cell types within the CNS of rats. In addition, promoter specific lentiviruses may also be used to achieve region, temporal, and cell-type specific gene manipulation *in vivo* in both mice and rats.

CRHR1 Haplotypes Moderate Effects of Early Life Stress (ELS) on Adult Depression (Ressler, leading a large collaborative project). Both genetic inheritance and environmental factors contribute to risk for Major Depressive Disorder (MDD). Among the most robust environmental predictors of adult MDD is ELS, which alters the function of the endogenous stress response axis, principally corticotropin-releasing hormone (CRH) and its downstream effectors. To test this, 15 single nucleotide polymorphisms (SNPs) spanning 57kb of the CRH receptor locus (*CRHR1*) within a primarily African-American, highly traumatized, inner-city sample (n = 422) were examined. We find significant gene x environment interactions with individual SNPS as well as with a common haplotype within the putative promoter region ($p = 0.00082$). Our data suggest an additive protective effect of *CRHR1* genetic variants against adult depression that is only revealed in the presence of ELS. These data support the CRH hypothesis of depression and suggest that a gene x environment interaction is critically important for the expression of the depression phenotype in adults with *CRHR1* risk or protective alleles who have a history of childhood trauma.

Effects of repeated immobilization stress (RIS) on the expression of I_A channels subunits and their attendant chaperone proteins in BNST neurons. (Rainnie, Guo, Hazra). For this study we used a four day, one hour per day, immobilization paradigm to examine the effects of stress on the intrinsic membrane properties of BNST neurons. Our immunohistochemical data suggest that RIS caused an apparent decrease in the expression of a specific subset of potassium channel interacting protein (KChiPs). We followed up these studies with an examination of mRNA expression for the I_A channels subunits as well as the KChiPs from tissue punches of the BNST. Intriguingly, RIS did not affect the expression of KChiP mRNA but caused a significant reduction in the expression of a specific I_A channels subunit (Kv4.2). We are currently examining the effects of the RIS manipulation on the firing properties of BNST neurons as well as the expression of the I_A channels subunit mRNA expression at the single cell level.

Examination of the intrinsic network properties of the BLA that contribute to the regulation of synchronized firing activity in BLA projection neurons. (Rainnie, Daftary, Jasnow). We now have

compelling evidence that the reciprocal connections between BLA projection neurons and parvalbumin-containing local circuit interneurons working in conjunction with intrinsic sub-threshold membrane oscillations in projection neurons help to entrain ensembles of neighboring projection neurons to synchronize their firing at ~ 5Hz (theta frequency).

Molecular tools with which to identify and manipulate discrete cell populations in the rodent BLA. (Rainnie, Ressler, Chhatwal, Jasnow, Hammack). We have developed several lentiviral vectors containing promoter regions unique to BLA interneurons which we will use to drive green fluorescent protein (GFP) expression. Data from the first of these viral vectors containing a cholecystokinin promotor region driving GFP expression has been published in the journal Gene Therapy.

In vivo simultaneous recording of amygdala and prefrontal cortical neurons (Rainnie, Mayberg, Potter, Madsen, Rolston). Our in vitro slice data strongly suggest that synchronized neural activity should be observed in the basolateral amygdala (BLA) in response to affective stimuli. We have hypothesized that during top-down control of emotion a form of affective binding occurs between the BLA and the prefrontal cortex in which synchronized firing in groups of neurons may become phase-locked at theta frequency. With support from a CBN venture grant we have constructed an in vivo recording module with which we can test the above hypothesis. For this study we proposed to use multielectrode arrays to simultaneously record unit activity and local field potentials (LFPs) from the BLA and infralimbic PFC. We first had to overcome several technical difficulties related to the construction of the electrode arrays as well as surgical implantation techniques, which considerably delayed the start of the study. However, we now have a system with which we can successfully record single unit activity and LFPs in the BLA and PFC and correlate this activity with ongoing behavior using a time-stamped video recording system. In our initial studies in the BLA we have been able to see an increase in theta frequency power in the LFP traces in response to the presentation of sound files containing ultrasonic vocalizations recorded from stressed rat pups. This observation is consistent with our hypothesis that salient affective stimuli would synchronize firing activity in the BLA.

Neural activity in the amygdala of human epileptic patients (Rainnie, Gross, Madsen, Rolston). In this study, patients already have electrodes implanted bilaterally into their temporal lobes to locate potential epileptic foci. We will use data generated in our rodent in vivo recording system to inform our analysis of LFP activity in the human amygdala.

Effects of early life stress (ELS) on fear and anxiety in rhesus monkeys: Neurobiological underpinnings (This is a large, multipart collaborative project that spans the Fear and Affiliation Collaboratories):

Abuse and Maternal Rejection Model (Sanchez, Wilson, Felger, Miller, Alagbe, Zhang, Graff, Grand, Maestripieri). Infant rhesus monkeys that experienced physical abuse and high levels of rejection by their mothers exhibit alterations in socio-emotional development. They exhibit behavioral signs of distress/irritability (high rates of tantrums and screams) and delayed social development. The infants also show alterations in monoamine neurotransmitter systems (in particular, low levels of serotonergic function, indexed by low CSF levels of 5-HIAA). Individuals with lower CSF 5-HIAA also scored higher in behavioral measures of anxiety and exhibited high levels of avoidance and solitary play during the juvenile period. These effects become sexually dimorphic during adolescence, with abused female macaques exhibiting more levels of fear (freezing, withdrawal responses) in the presence of novel stimuli than non-

abused, matched controls; on the other hand, abused males exhibited more impulsive aggression than controls.

In the past year we have also found a strong association between maternal abuse and rejection experienced as infants and increased levels of inflammatory markers (MAPK p-p38), which is of significant relevance because it links early life stress with somatic disorders that develop later in life, in addition to psychopathology. Stress results in activation of innate immune responses including release of proinflammatory cytokines. Relevant to the impact of ELS on 5-HT function, activation (phosphorylation) of the p38 MAPK signaling cascade by cytokines increases the activity of the 5-HT transporter. Our study investigated the relationship between the activation of inflammatory signaling pathways and brain 5-HT function in juvenile macaques maltreated as infants. Increased p38 activity was associated with decreased 5-HIAA in CSF and increased maternal rejection.Our data provide the first evidence of an *in vivo* relationship between activation of p38 MAPK signaling pathways and brain 5-HT function in an animal model of ELS and indicate that activation of inflammatory signaling may participate in the contribution of ELS to psychiatric morbidity.

Repeated Maternal Separation Model: (Sanchez, McCormack, Ely, Lyon, Boudreau,M., Noble, Parr, Nemeroff, Winslow, Votaw, Goodman, Kilts). We are investigating the consequences of repeated maternal separation during sensitive periods of social and emotional development in rhesus monkeys. We have reported short-term effects, such as delayed social development and sensitization of the infant's hypothalamic-pituitary-adrenal (HPA) axis to the separations, particularly in females. The maternal separation protocol also produced long-term alterations in HPA axis function (e.g. flattened diurnal rhythms of cortisol secretion, blunted ACTH response to CRF) and emotional behavior (increased anxiety, as demonstrated by their elevated baseline startle), detected during the juvenile period. The brain serotonin (5-HT) systems play an important role in the regulation of emotionality and stress physiology, and their development is sensitive to alterations in the early environment. During the last year we have studied the serotonergic function of maternally-separated macaques. Our findings indicate an enduring impact of repeated maternal separation on the development of brain 5-HT function, as reflected by:

1) Alterations in 5-HT transporter (5-HTT) binding in several brain regions detected using *in vivo* positron emission tomography (PET). Reduced 5-HTT availability was detected in orbitofrontal cortex, brain stem and temporal lobe (amygdala-hippocampus). 5-HTT availability is used as an index of serotonergic function because the density of the transporters generally correlate with that of 5-HT axonal terminals.
2) CSF levels of 5-HIAA (5-HT metabolite) , but not 5-HT, were elevated suggesting increased turnover of this monoamine. Interestingly, inverse relationships between brain stem 5-HTT binding and CSF 5-HIAA levels have been previously reported in this species.

Interestingly, reduced 5-HTT availability in orbitofrontal cortex and brain stem was associated with increased HPA axis activity and anxiety (measured as elevated baseline startle in an acoustic startle paradigm), respectively.

These studies provide evidence that early life stress in nonhuman primates is associated with long-term changes in emotionality, including increases in fear/anxiety levels. Our findings also suggest that alterations in serotonergic function caused by the early adverse experiences may be an important risk factor for this developmental psychopathology and vulnerability to somatic disorders.

Role of the primate amygdala in fear-potentiated startle: effects of chronic lesions in the rhesus monkey (Davis, Winslow). In Experiment 1, we assessed the role of the primate amygdala and hippocampus in the acquisition of learned fear measured with fear-potentiated startle. Three groups of six rhesus monkeys were prepared with bilateral, ibotenic acid lesions of the amygdaloid complex, the

hippocampus, or sham operated. Selective ibotenic acid lesions of the amygdala, but not the hippocampus, blocked the acquisition of fear-potentiated startle. In Experiment 2, we assessed the role of the primate amygdala in the expression of fear-potentiated startle. Surprisingly, animals that sustained amygdala damage after they successfully learned fear-potentiated startle expressed normal fear-potentiated startle, despite a complete amygdala lesion based on MRI assessments. These results suggest that while the amygdala is necessary for the initial acquisition of fear-potentiated startle, it is not necessary for the retention and expression of fear-potentiated startle. These findings are discussed in relation to the role of the amygdala in emotional learning and in cross-species comparisons of emotional behavior.

Effects of fear conditioning on Manganese-enhanced circuit tracing in an identified neural circuit (Keilholz, Davis). The goal of this project is to use manganese-enhanced MRI (MEMRI) to detect differences in activity induced by an olfactory cue in naïve and fear-conditioned animals. Manganese administration has been optimized and an analysis technique has been developed to provide statistical maps of differential enhancement throughout the olfactory tract including the olfactory bulb, piriform cortex, and amygdala. Preliminary results have indicated that in mice, MEMRI is sensitive to altered levels of neural activity during olfactory stimulation. Mice that were exposed to the strong odor of propanol after manganese administration showed significantly less manganese uptake and transport, possibly due to lateral inhibition in the bulb. A paper about this experiment has been submitted to Magnetic Resonance in Medicine.

We have begun to examine the effects of fear conditioning on manganese uptake and transport during odor exposure in rats. Five experimental groups have been imaged using a 9.4 T animal scanner including: no odor, no fear conditioning; propanol, no fear conditioning; propanol paired with fear conditioning; propanol and fear conditioning unpaired; and acetophenone,paired with fear conditioning. Data processing and analysis is currently underway.

Role of the amygdala in extinction. (Myers, Davis, Ressler). There have been no significant changes, although progress has been slower than anticipated due to persistent difficulties in obtaining reliable extinction in rats over the past nine months. We suspect this is because of conditions in the animal colony that are stressful to the rats. We have been working with the colony manager to remove those conditions and anticipate that our behavioral assays will improve once this is complete. In the interim I have been pursuing other approaches, including (1) examining the molecular pathways activated within the basolateral amygdala following fear acquisition, with the goal of eventually examining the modulation of those pathways in animals exposed to short interval fear extinction; (2) using cell type-specific markers (e.g., parvalbumin, calbindin) coupled with Fos activation to explore the cell populations within the basolateral amygdala that are activated following conditioned fear acquisition and extinction; and (3) using transgenic mice to examine the role of NMDA receptors within the basolateral amygdala, hippocampus, and neocortex in conditioned fear acquisition and extinction, as well as other learning tasks.

Phasic vs. Sustained Fear: An operation definition of fear vs. anxiety and the role of CRF-1 receptors. (Walker, Miles, Davis). During this period, we developed and refined a procedure for producing sustained increases in startle amplitude (a marker of fear) using long-duration conditioned fear stimuli. The objective was to test specific predictions derived from a neural circuit model that postulates differences in the neural substrates of short- versus long-duration (i.e., phasic versus sustained) fear responses. This work was initiated in the previous period and has come to fruition in the present. We can now reliably produce a sustained increase in startle using an 8-minute presentation of a clicker stimulus that has previously been associated with shock. Using this procedure, we recently found that systemic

administration of a CRF receptor antagonist blocks sustained but not phasic fear responses to the clicker stimulus. These results replicate those of an earlier experiment conducted during the preceding period in which we used an earlier and less reliable design.

Also, findings from the preceding period indicated that infusions of an AMPA receptor antagonist into the bed nucleus of the stria terminalis (BNST) disrupted startle increases that occurred during the last several minutes of an 8-min conditioned fear stimulus (CS), but not those that occurred during the first several minutes of the conditioned fear stimulus, and suggested that just the opposite may be true for infusions into the central nucleus of the amygdala (CeA). During the current period, the number of animals with CeA infusions has been increased. With complete groups, it now appears that intra-CeA NBQX infusions do not at all disrupt startle increases to the 8-min CS, even during the first several minutes. Thus, there appears to be a clear dissociation between the involvement of AMPA receptors in the CeA and BNST with conditioned fear stimuli, as previously suggested by results of a study in which we compared the effects of these treatments on short-duration conditioned fear responses and longer duration unconditioned fear responses (J Neuroscience 17:9375). We have also found, using the newest version of this paradigm, that infusions of a CRF receptor antagonist directly into the BNST also disrupt sustained fear responses, thereby strengthening the case for an involvement of the BNST and also of CRF receptors in these types of responses. Other findings obtained during this period indicate that pre-training knife cuts, which isolate the BNST from the amygdala (a rich source of CRF to the BNST) as confirmed by retrograde tracer studies, prevent sustained fear responses. As this treatment was also associated with marked health impairments, however, further experiments will be necessary in order to attribute the effects on startle increases specifically to transection of the amygdala->BNST pathway).

During this period, we completed studies in which we evaluated the effect of a systemically administered CRF receptor antagonist on startle increases produced by intra-ventricular CRF infusions, a phasic conditioned fear stimulus, and sustained exposure to bright light (an unconditioned anxiogenic stimulus). The most significant work during this period involved an evaluation of progressively lower doses of the drug on light-enhanced startle.

We also began and completed an evaluation of the effects of systemic administration of several ligands that enhance the function of Group II metabotropic (glutamatergic) receptors. Most of these compounds were ineffective, presumably due to poor brain penetration. One compound however, completely blocked fear-potentiated startle to a phasic fear stimulus while at the same time markedly increasing baseline startle amplitude.

Estrogen disrupts the inhibition of fear in female rats, possibly through antagonistic effects of ERα and ERβ. (Toufexis, Davis)**.** The ambiguous role of estrogen in emotional learning may result from opposing actions of ERα and ERβ. Using a fear-conditioning paradigm called the AX+, BX- discrimination, in which cue A comes to elicit fear while cue B becomes a safety signal, we examined the effect of 17β-estradiol (E) and selective ERα and ERβ agonists on excitatory and inhibitory fear learning. Gonadectomized (GDX) male and female rats implanted with E or selective ERα or ERβ agonists were trained on the AX+, BX- discrimination and tested periodically to A, B, and AB. GDX sham-implanted male and female rats and GDX E-implanted males, but not GDX E-implanted females, exhibited less fear to AB than to A, suggesting that estrogen interferes with generalization of safety signals in female rats. ERα and ERβ agonists disrupted discrimination learning in both sexes. ERα-implanted groups had higher fear responses to all cues than did ERβ-implanted groups, suggesting that these two receptors have opposing effects in aversive discrimination learning. In contrast, neither E, nor ERα and ERβ agonists, affected single-cue fear conditioning in either sex. These data suggest that E does not enhance fear in emotional learning but acts to disrupt the inhibition of fear in females only

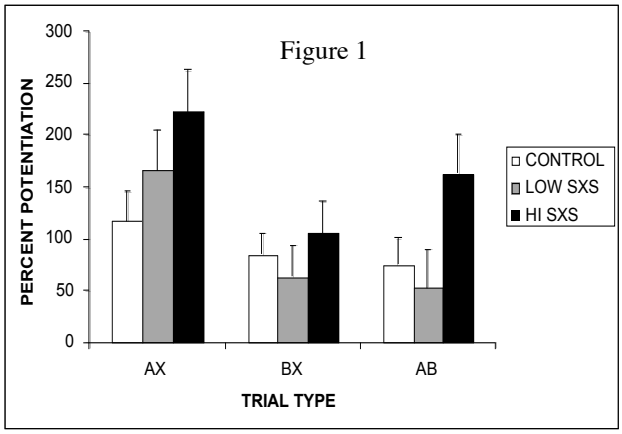
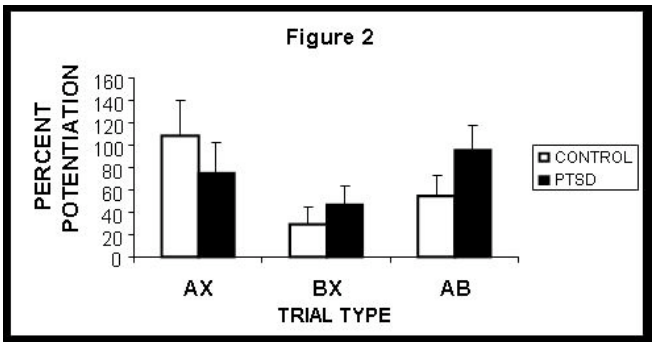


Figure 1. AX+/BX- data from Atlanta VA. Percent startle potentiation to the different trial types by PTSD group (healthy controls, low symptom PTSD, high symptom PTSD.

Fear Conditioning Studies in PTSD (Duncan, Norrholm, Jovanovic). We have examined inhibition of conditioned fear in two fear-potentiated startle paradigms: conditional discrimination (AX+/BX-) and fear extinction. The AX+/BX- paradigm was previously developed in animals by Dr. Davis' lab and adapted to our human studies. In this paradigm, subjects are presented with one set of colored lights (AX trials) paired with aversive airblasts to the throat, and a different series of lights (BX trials) presented without airblasts. Lights A and B are then presented together (AB trials) to determine whether B inhibits fear potentiation to A. Therefore, we condition A to be a "danger" signal, B to be a "safety" signal, and then present A and B together to see whether the "safety," or inhibitory properties of B reduce potentiation to the "danger" signal A. The advantage of this paradigm is that is independently measures enhanced fear responses to danger cues and impaired responses to safety cues. In our work from prior years, healthy subjects show fear potentiation to AX, discrimination between AX and BX, and significant fear inhibition on AB trials. In our follow-up study, we analyzed fear inhibition in 28 controls and 28 PTSD patients with high (N=14) and low (N=14) PTSD symptoms using the AX+/BX- paradigm. As in the first study, control subjects showed significant discrimination between AX and BX ($F(1,27)=4.54$, $p<0.05$) and significant inhibition on the AB trial relative AX ($F(1,27)=5.67$, $p<0.05$). Both high and low symptom PTSD patients displayed excellent discrimination. However, Atlanta VA veterans with PTSD with the highest symptoms did not show transfer of inhibition (had significantly less inhibition of fear on AB trials; see Figure 1).

We have also used the AX+/BX- paradigm in 33 subjects from Croatia (16 controls and 17 PTSD patients). The controls showed more fear-potentiated startle in the presence of AX+ than BX- ($F(1,15)=11.59$, $p<0.001$); and inhibited potentiation to AB compared to AX+ ($F(1,15)=7.61$, $p=0.01$). On the other hand, the Croatian veterans with PTSD did not show significant discrimination between AX and BX and did not transfer safety to the AB trial relative to the AX trial (see Figure 2). These data show that the Croatian PTSD population also shows impaired fear inhibition that can be detected with our AX+/BX- paradigm.

Figure 2. AX+/BX- in Croatian subjects. Controls show normal fear inhibition, while PTSD patients do not.



Finally, we developed a startle paradigm measuring extinction of acquired fear. We tested 40 healthy volunteers in a simple discrimination (A+/B-) extinction paradigm. The experimental procedures occurred over two days: Day 1 (Fear Acquisition) and Day 2 (Extinction Training). A 75% schedule of reinforcement was used during the Acquisition phase to prolong the development of within-session extinction on Day 2. Conditioned stimuli consisted of two colored lights (A and B) and the unconditioned stimulus (US) was an airblast to the throat. During Fear Acquisition on Day 1, this conditioning protocol produced significant potentiation to light A and significant discrimination between lights A and B. During Extinction Training on Day 2, subjects displayed significant within-session extinction of potentiated startle ($F(1, 27)=9.34$, $p=0.005$). Finally, an additional subject group received three unpaired presentations of the airblast US over 3 minutes at the end of Extinction Training to assess reinstatement of potentiated startle. The unpaired US presentations produced a significant return of potentiated startle, i.e., reinstatement of fear ($F(1, 21) = 10.48$, $p = 0.004$). Thus we have developed a paradigm that successfully demonstrates acquisition of fear conditioning, extinction, and reinstatement in human control subjects. We are now recruiting and running PTSD subjects on this paradigm to detect abnormalities in extinction and reinstatement that we hypothesize will be present in this population.

fMRI studies of fear and anxiety in humans (McClure, Anderson). In the past year, work has continued to focus on examining associations between anxiety and patterns of human neural and behavioral response to fear-provoking cues embedded in social contexts. Two primary ongoing studies form the core of my lab's research at present. With funding support from the GSU Brains and Behavior program as well as CBN support, Dr. McClure, in collaboration with Dr. Eddy Nahmias, a philosophy professor at GSU, has nearly completed data collection for both fMRI and behavioral studies of neural and behavioral responses to cues of cooperation and betrayal in college students with high and low levels of social anxiety. Additionally, with pilot funding from a GSU Research Initiation Grant, data collection is underway for a second set of fMRI and behavioral/eye movement tracking studies aimed at examining college students' responses to positive and negative evaluation from peers. A new set of fMRI studies are currently underway. In addition, Drs. McClure and Anderson were both recently awarded a Junior Faculty Research Grant from the Anxiety Disorders Association of America to conduct research examining neural predictors of treatment outcome in individuals with social anxiety disorder who undergo virtual reality-based cognitive behavioral therapy. Data collection will begin this fall.

iv. Reproduction and Sex Differences Collaboratory

The research in the **Reproduction and Sex Differences Collaboratory** (RSD) results from interactions among faculty that have occurred in our collaboratory meetings and all projects involve multiple laboratories. The Reproduction and Sex Differences Collaboratory agreed over this last year that sex differences in behavior and neural function are an overarching theme in the collaboratory's research.

Thus, the Reproduction Collaboratory combined with the new Sex Differences Collaboratory to form the Reproduction and Sex Differences Collabroatory that integrates sex differences into the research efforts. We anticipate that this will lead to integration with research in other collaboratory areas as well as a more programmatic development of venture grants within the Collaboratory. Progress is described on four collaboratory projects funded by active venture grants to highlight the RSD Collaboratory's cross collaboratory interactions.

A computerized testing system to investigate sex differences in rhesus monkey visual cognition. (Martin-Malivel, Wallen, Bachevalier) This project investigates sex differences in visual cognition established in humans, but uninvestigated in nonhuman primates. This will be the first experimental application of the touchscreen computer kiosks developed in conjunction with the Behavior technology core. The project will investigate whether rhesus monkeys show a sex difference in mental rotation, the most reliable cognitive sex difference in humans. More than 40 male and female rhesus monkeys living in a long-term social group will have access to a touchscreen kiosk via rfID chips implanted in their forearms. These chips, which uniquely identify individuals allow them to 'log in' to the computer to access the mental rotation software under development. Using a match to sample paradigm, this study will replicate human studies using the Shephard Metzler figures that have been used to demonstrate the human sex difference in spatial cognition. This study will be the first to investigate spatial cognition in rhesus monkeys using a large sample size and should significantly advance our understanding of comparative aspects of sex differences in cognition.

Developing a model to study the adverse effects of metabolism in primates. (Wilson, Bartness, Harris, Fischer). This is a joint project between the Reproduction Collaboratory and Behavioral Technology Core. Rates of obesity continue to rise in children which have adverse effects on growth and development and place them on a trajectory for secondary health problems as adults. New data from rodent models indicates that stress induces the consumption of highly palatable, calorically dense foods (comfort food) at the expense of normal chow. Consumption of this chow attenuates the neuroendocrine response to stress and, not surprisingly increases fat mass. Non-stressed animals show no preference for the comfort food. Funds provided by a CBN venture grant enabled validation and implementation of a system to quantify food intake by individual rhesus monkeys living socially. Consumption of the low fat and high fat diet was quantified by means of a custom-built automated feeder (See Behavior Tech Core progress report) that dispensed a pellet of food when activated by a radiofrequency chip implanted subcutaneously in the female's wrist. Food intake and thus calories consumed can be quantified 24 hours a day, seven days a week. In the initial study, we tested the hypothesis that socially subordinate females would consume more calories from fat than dominant animals, based on the notion that exposure to chronic stress, imposed by subordinate status, would change food preferences. The data show socially subordinate females consumed significantly more of both the LFD and HFD throughout a 24 hr period while dominant females restricted their intake of the diets to the daytime hours. The amount of calories consumed significantly predicted the gain in body weight during the three-week intervals. The results of this study indicate that food intake can be reliably quantified in macaques living in complex social environments. Furthermore, the data suggest that socially subordinate females living in long-term stable groups over consume both a LFD and HFD, suggesting that this ethologically valid model could be used to better understand how psychosocial stress changes preferences for and consumption of food, leading to an obese phenotype.

Behavioral effects of neonatal amygdala lesions in monkeys living in a semi-naturalistic environment. (Bachevalier, Wallen). This is a cross-collaboratory project with the Fear Collaboratory.

Neonatal amygdala damage in monkeys yields behavioral changes that emerge in early infancy (Machado & Bachevalier, Child Psychol Psychiat 2003:44). Yet, none of the earlier studies used the rich and complex social environment in which infant monkeys typically live to assess the effects of early amygdala lesions on emotions and social behavior. Here the investigators studied the effects of neonatal amygdala damage on early social behavior of male rhesus monkeys (*Macaca mulatta)* reared in an established rhesus monkey group of 98 adult females and 76 offspring organized in 12 matrilines. Significant alterations in behavior were found with Amygdalectomized monkeys showing earlier independence from their mothers, receiving less grooming from their mothers, increased rough play and increased abortive mounting. The lesioned males successfully integrated themselves into the group for the first 15 months of life, until they were removed for neuroanatomical validation of the lesion sites. These pilot data demonstrated that monkeys without a functional amygdala can live in a social group, even though their social behavior is substantially modified. These pilot data were used for an application to NIMH for a full scale study including females to allow investigation of sex differences and it appears that this proposal will receive funding for this project.

Automatic tracking and analysis of monkey proximity initiation in an outdoor social group. (Balch, Wallen). This is a joint project of the Reproduction Collaboratory and Behavioral Technology Core. Proximity initiation is one of the signal behaviors used by rhesus females to indicate their interest in sexual activity with males. In addition, it is used to establish and maintain social relationships with groups of females through matrilineal based grooming networks. This project is developing the technology for automated tracking of all of the adult females and males within a social group. To provide the spatial resolution necessary to track proximity, overlapping scanning lasers (eye and monkey safe) can resolve objects within the environment to a distance of 2cm and distinguish fixed from moving objects. We originally hoped to uniquely identify subjects with an active rf tag, which broadcasts each subject's identity to receivers near the monkey's home compound. However, objects within the compounds alter the rf signal too extensively to accurately track monkeys. We are now investigating the us f rf LEDs on the monkeys to identify them and allow tracking. Software developed on this project with integrate the two sources to provide individual tracking data for all animals in the group. This will allow collecting the most extensive data on patterns of association and proximity initiation between males and females ever obtained. We are expecting to test this on a group of monkeys are the Yerkes National Primate Research Center Field Station this fall. It has been a particularly challenging project that has already led to significant advances in the underlying computer software to provide recognition of individuals moving in 3D space in a complex social context.

v. Memory and Cognition Collaboratory

The Memory and Cognition Collaboratory (MCC) is the newest group within the CBN and cuts across all the traditional Collaboratories. The MCC stimulated several new collaborations and brought several new investigators into the CBN with ideas for new cross-cutting research projects. Attendance at its meeting has been very encouraging. In an effort to stimulate collaboration and discussion, the MCCC adopted a "Foundations in Five" format for its meetings in the first year to acquaint MCCC members with a bigger picture of participant's respective area, rather than with the latest data from participant's labs. This format has been continued this year, although more presentations have been preliminary venture grant proposals during which presenters receive feedback from the group on their proposed work. Foundations in Five presentations are meant to last for only 5 minutes, during which the speaker presents a core concept or core problem from his/her area of expertise. This issue or concept is more general than any project ongoing in a particular laboratory, although current work is likely directed at addressing the issue in the long term. Of

the 22 presentations given so far almost half were presented by faculty newly recruited to the Atlanta area. Discussion has been active to the point that meetings have run longer than expected. Eleven venture grants have been submitted through the MCCC and 6 have been funded. Several other funded proposals involve the MCCC. Thus the MCCC appears to be stimulating identification of areas ripe for new collaborative research that will advance work in areas bridged by the themes of Memory and Cognition. Highlights of recent research from MCC members are listed below.

Imaging medial temporal lobe activity related to memory and emotion in awake, behaving monkeys. (Alvarado, Bachevalier, Hamann, Hampton). Under funding from a CBN venture grant, the investigators collaborated with Dr. Tim Duong's group (Yerkes MRI; member of the CBN Imaging Core) and achieved their goal of building a primate chair suitable for functional imaging of awake, behaving monkeys. They have purchased and trained two monkeys to enter the chair and accept collar restraint, and with the assistance of Ikuma Adachi (CBN postdoc, Hampton lab), have trained the first of two subjects to lie prone in the chair and view videos with scanner sounds played in the background. This monkey is trained to the point that she only occasionally attempts to move, which is essential for quality imaging. A critical feature of the chair is the head restraint, which is currently being tested and modified for optimal motion reduction. In addition, the investigators are constructing the pool of visual stimuli, which will be validated using monkeys from Dr. Bachevalier's colony. It is anticipated that they will be able to begin the initial scans this fall.

Using a computer-interfaced behavioral tool to conduct cognitive research on orangutans in a semi-natural environment (zoo) and to educate the public about primate behavior. (Stoinski, Powell, Hampton, Basile) This joint research-education project was funded through a venture grant as a collaboration between CBN and Zoo Atlanta to develop an interactive program that will permit zoo visitors to observe and learn about the primate cognitive research program at the Zoo while research on primate cognition is undertaken. Through joint contributions from each partner, an artificial tree has been constructed in one of the outdoor habitats that contains a computer interface for presenting cognitive tasks to orangutans. Through the development of additional collaborative ties with the Hampton lab at Yerkes, computer programs have been written and are being used effectively to train apes in matching-to-sample. Structured, advertised programs held four to five times weekly teach visitors about the cognitive program at the zoo and allow them to observe while orangutans participate in cognitive experiments. In addition, a kiosk on the public side of the habitat provides interpretive materials via a video loop and allows visitors to directly perform cognitive tasks similar to those presented to the orangutans. In the research portion of the project, a matching-to-sample task is being used to test questions related to social cognition (face recognition) in nonhuman primates. Four subjects are currently in various phases of training on a basic matching-to-sample task. Once we have multiple animals that have reached criteria on the matching-to-sample program, more complex comparative cognition tasks will be possible in a semi-naturalistic setting.

Cognition and medical adherence in older adults with type 2 diabetes. (Parent, McClure, Umpierrez, Wild) A small pilot project is underway to obtain data to support grant applications for studying the effects of type 2 diabetes on memory performance and other cognitive processes. This work on humans stems directly from Dr. Parents animal studies on glucose disregulation and memory function (funded in the past with CBN support). In addition, through Dr. Umpierrez, a connection with a translational aspect has been made, whereby results here will be examined in relation to patient's capacity for adherence to medical instructions. This is a major problem in diabetes management, and as such the results have the potential for making a significant impact on health programs. We have given 72 diabetic patients a very thorough neuropsychological assessment. We are awaiting the results of the analyses of their blood in order to

determine whether there is a relationship between inflammatory markers, blood glucose regulation and cognitive performance.

An examination of evolutionary specializations into auditory memory. (Parr, Zola) This recently funded project will examine the ability of chimpanzees to learn auditory matching-to-sample and will compare their ability to that of humans and other primates. The first subject has experienced about 5000 trials, and is still in the early phase of training.

vi. Reward and Reinforcement Cross-Collaboratory Group

The Reward and Reinforcement Cross-Collaboratory is a new group that cuts across the traditional Collaboratories to stimulate interactions among CBN members interested in common brain areas, circuit architecture, and neurochemicals involved in reward mechanisms for various behaviors. The goal of the group is to stimulate new collaborations in this research area, and to provide support from the CBN scientific community for the processes of experimental design and preparation of grant proposals. General areas of interest to the cross-collaboratory participants include how concepts of brain reward and reinforcement systems apply to studies of pair bonding, food intake, and general responding to environmental stimuli (i.e. assigning valence to stimuli in reward or fear models). Common cellular and molecular mechanisms across stimulus modalities in an organism, and across animal model systems or species, are under investigation. To date these meetings have helped generate interest in this area and stimulated new collaborations (e.g. Frantz – Katz Labs) and external grant proposals (e.g. Potter Lab). Several projects that have emerged from this group are in various stages of development. Three are described briefly below.

Nucleus Accumbens Efferents in Reward and Reinforcement (Frantz, Neill, Doherty, Romine). This newly formed collaboration between labs at Georgia State University and Emory University is comparing the role of efferent GABAergic projections from the nucleus accumbens to target regions (ventral pallidum, substantia nigra, VTA) in behavioral reinforcement by natural and artificial reinforcers, such as food (sucrose pellets), drug (intravenous amphetamine infusions), or brain stimulation (intracranial electrical impulse) in adult male rats. Results suggest that the role of the ventral pallidum is less robust in responding to natural reinforcers, compared with processing artificial stimuli. In contrast, the substantia nigra pars reticulata appears similarly involved in all tested reinforcement processes. This work represents an important step in illuminating the circuitry underlying different types of reinforcers and in determining how rewards associated with natural animal behavior relate to the well described reinforcement system accessed by psychoactive drugs.

Establishment of Reward and Reinforcement Models in the marine mollusc, *Aplysia californica*
(Calin-Jageman, Katz, Frantz, Ajlen). While dopamine-based reward systems and behavioral paradigms for studying them are well established in mammals and other vertebrates, nothing is know about reward systems in invertebrates. Dopamine and other catecholamines are known to be neurotransmitters in various invertebrates and to have powerful neuromodulatory effects, but whether they have any role in learning, particularly a role in reward as in vertebrates, is unknown. Through recent venture grant funding, a novel collaboration has been established between the Katz lab, which studies neuromodulator processes in gastropod mollusks, and the Franz lab, uses pharmacological methods to investigate the dopamine-based reward systems in rats. Their project has begun to investigate the behavioral effects of amphetamine on the marine mollusc, *Aplysia californica*, and to develop a behavioral paradigm for studying reinforcement-based learning in this well studied invertebrate. This effort lays solid groundwork for developing a

simplified physiological preparation for studying the rewarding aspects of psychoactive drugs applied directly to *Aplysia* ganglia.

Reward and Reinforcement in Embodied Cultured Networks (Potter, Haynes, Rolston, Mansjur). The Potter lab at Georgia Tech takes a neuroengineering approach to basic questions in neuroscience. They have developed an in vitro, cell-culture based system for studying the electrical interactions among simple, artificial neural systems. This group has now built a system for delivering spatially and temporally localized neuromodulators to cultured cortical networks interfaced with multielectrode arrays. This will be used to study the effects of dopamine agonists on learning in vitro, in a paradigm allowing recorded neural activity to control the delivery times and locations of its own "reward" stimuli.

vii. The Cores

The core labs were developed to focus on target technologies that are considered high priorities by Center faculty for behavioral neuroscience research. Cores have assisted CBN faculty in many projects and collaborated on several Venture Grant funded projects that developed new techniques or applications in concert with research studies. Through hiring professional technicians and presenting training workshops, Center faculty, postdocs and students are familiarized with the core technologies and are encouraged to utilize these technologies in their own research.

Molecular Core: **Dr. Byron Ford (MSM) Head:** The CBN Molecular Core was established to provide unique and powerful molecular tools and models to examine gene expression profiles in the nervous system. The goals of the Core are to (1) provide rapid, accurate, and state of the art microarray technology to the CBN, and (2) provide bioinformatics support for interpretation of microarray gene expression profile analysis. During the previous report period the Core capabilities were enhance by equipment purchased using a W.M. Keck award received by the Morehouse School of Medicine. This included equipment for Laser Capture Microdissection, an additional real-time PCR cycler and a Lumicycle system to follow gene expression in living cells. We have also recently hired a research technician, Ju Jiang, who has significant expertise in microarray data analysis. The core has also been a valuable resource to investigators in the CBN and the Atlanta Neuroscience community at-large. Molecular Core personnel have assisted three CBN members in writing Venture Grants and collaborative studies are underway to examine gene expression profile changes resulting from specific behaviors. Of particular note is a collaboration with researchers in the **Aggression Collaboratory** to develop a microarray to investigate patterns of differential gene expression in dominant vs. subordinate hamsters. Several publications have been generated describing work supported by the Core.

Cellular (Viral Vector) Core**: Dr. Kerry Ressler (Emory), Head:** This core focuses on the development of viral vectors for use in behavioral experiments. This service allows use of genetically modified lentiviral vectors to perform experiments such as 1) overexpressing genes of interest within a brain region, 2) knocking-down genes of interest with siRNA viral vectors, 3) inducibly removing genes of interest by expressing Cre Recombinase in transgenic mice that are transgenically modified with loxP sites flanking specific genes, 4) providing cell-type specific labeling using cell-type specific promoters. In addition, a new tet-on inducible lentivirus vector has been created and is ready for use; this unique vector put both rtTA and inducible miniCMV promoter in a single vector. Additional new work is focused on using lentiviral vectors to express small interfering RNA (siRNA) to silence gene expression in vivo in conjunction with behavior. Over the past year (from Sep.1, 2006 to Aug 31, 2007) the activities of this core have produced several viral vectors for CBN labs including:

- CMV/CRF/IRES/GFP
- pCMO2/GFP
- GRP1.7-GFP
- LV-CCK-GFP
- LV-CMV-CRE
- LV-CCK-CRE
- LV-CART
- LV-TrkBt1
- LV-Red-Tai
- FUGW
- LV-siRNA-Gephyrin

These viral constructs have been used successfully in studies and have resulted in several abstracts, publications and talks. Of particular note, the cellular core is participating on a venture grant project with researchers in the aggression and memory and cognition collaboratories which I ncludes developing viral vector methodology for application in lizards. Preliminary results using a lentavirus have been promising. If these preliminary results hold, this will represent the first use of viral vector methodology in a cold-blooded vertebrate. This demonstrates the Viral Vector Core's success in extending this cutting-edge technology to nonmammalian systems for use in neuroethological research. The success of the CBN Cellular Core has prompted an immense interest in using this technology in behavioral based research as evidenced by the several inquires per month directed through the Viral Vector Core. The active collaborations between the CBN and the Viral Vector Core which illustrates the CBN's strong commitment and interest in using this powerful research technology.

***Viral Tract Tracing Core (formerly Systems Core)*: Dr. Tim Bartness (GSU), Head:** The purpose of this core is to develop and implement viral transneuronal tract tracers to meet the needs to map entire neural circuits within the same animal. In addition, the core has specialized in combining viral tract tracing with other neuroanatomical techniques such as *in situ* hybridization for neural receptors yielding circuit maps with co-localized receptors that subsequently can be used to guide site-specific microinjections of receptor agonists or antagonists to turn these circuits on or off, respectively. The Viral Tract Tracing Core is divided into two parts. Dr. Lynn Enquist (Princeton University) heads viral development. Dr. Enquist is a virologist with specialization in the development of viruses that can be used for trans-synaptic tract tracing. He develops viruses and sends them to Dr. Bartness (GSU) for *in vivo* testing. The parental PRV (as well as its genetic recombinants) and viral tract tracing technological training is then made available to CBN and non-CBN members who then apply it in their own research. They are currently primarily using variants of the pseudorabies virus (PRV), because of its genetic modifiability, to create new and improved methods for defining synaptic connectivity through this retrograde tract tracer that labels circuits from the ends to their beginnings. PRV is an ideal viral tracer, in contrast to other possible tracer viruses in that PRV is infectious to numerous animal species including populare research models such as rats, mice, and hamsters, but is non-pathogenic to humans (BSL1). In addition, the Viral Tract Tracing Core recently has acquired an anterograde transneuronal tract tracer, the H129 strain of the of herpes simplex virus-1 into the virus repertoire. This virus is unique in that it labels sensory circuits, from peripheral origins to its central targets (as well as central circuits from their beginnings to their ends

The Viral Tract Tracing Core has trained numerous researchers at the CBN and elsewhere in these techniques, and currently is working on projects with the fear, reproduction and aggression collaboratories,

using viral tract tracing methods to examine the anatomical substrates of various functional systems. The methodological developments and their project applications are as follows:

1. Double virus tract tracing using two recombinant isogenic versions of PRV for simultaneous visualization and comparisons of two circuitries within the same animal.
2. Combined viral tract tracing with conventional (monosynaptic) retrograde or anterograde tract tracers to visualize and compare relative connectivity within circuits within an animal
3. Combined transynaptic retrograde and transynaptic anterograde viral tracers to compare sensory and autonomic circuit to specific target tissue
4. Develop use of viral anterograde tract tracer to study complete sensory circuits from target tissue to brain.
5. Develop a means to study the physiological response (c-Fos induction) and behavioral relevance of circuitry from brain to peripheral targets labeled with viral tracers, to specific stimuli.

The Viral Tract Tracing Core has also trained, consulted, or collaborated with the following individuals to date:

Greg Demas (Indiana Univ) 2002
Krzystof Czaja (Poland) 2003 (now at Wash St Univ)-2006-present
Jill Schneider/Carol Buckley (Lehigh University) 2003
Colleen Novak (GSU) 2003
Denis Richard (Laval Univ) 2003-present
Mary Karom (GSU) 2004-present
Bruce Banfield. (Univ Colorado) 2004-present
Megan Mahoney, PhD (MSU) 2005
Saverio Cinti (Univ Ancona, Ancona, Italy) 2003-present
Bob Johnston (Cornell) 2004-present
Thomas Schoenfeld (UMass Medical School) 2005-2006
Larry Young (Emory) 2006-present
Anne Murphy (GSU) 2006-present
Aras Petrulis (GSU) 2006-present
TracyAnn Perry, (Discovery Biology) – industry, 2006-2007
Yasuhiko Kondo (Nippon Medical School, Tokyo, Japan) 2007

***Imaging Core*: Dr. Xiaoping Hu (Emory), Head:** The CBN imaging core has continued with providing imaging service to CBN researchers and potential CNB researchers and also acquired an upgrade for improved imaging capability. The projects that have utilized the imaging core range from functional imaging of rodents and ferrets, diffusion tensor imaging, and molecular imaging contrast evaluations.

Functional MRI (fMRI) is a major focus of the imaging core and benefits from the high magnetic field of our 9.4T instrument in terms of improved spatial specificity of brain activation. fMRI in animal models is heavily influenced by the anesthesia used. Recently, we have evaluated the utility of a newly adopted anesthetic agent, medetomidine, which is capable of survival studies, in rat fMRI and demonstrated a number of advantages. This work has been accepted for publication by NeuroImage (1) and has laid foundation for future fMRI studies including the ferret study of Dr. Sarah Pellas. Dr. Pellas' group continues to refine their fMRI protocol of ferrets.

Dr. Shella Keilholz, a CBN member, has been utilizing the imaging core for three studies. 1. *Characterization of functional connectivity in the rat.* Her lab is developing an animal model in which the physiological basis of functional connectivity MRI can be explored. 2. *Functional development of the*

olfactory tract in neonatal rats. Manganese-enhanced MRI is used to examine the uptake and transport of manganese in the olfactory pathway of rat pups at 1, 3, 5, 12, and 21 days after birth to characterize the functional development of the system. 3. *Sensitivity of manganese-enhanced MRI to odor-induced activation in the olfactory bulb (part of a study funded by CBN involving MRI detection of alterations in the olfactory pathway induced by fear conditioning).* The uptake and transport of manganese throughout the olfactory tract was examined in mice exposed to home cage odors compared to mice exposed to propanol. Significant differences were found between the two groups, with the propanol-exposed mice demonstrating decreased uptake and transport compared to the mice returned to their home cage. A paper has been submitted to Magnetic Resonance in Medicine detailing these findings.

Diffusion tensor imaging (DTI) is another tool that we have provided to the researchers and continue to develop. With the help of the imaging core, Dr. James Rilling has conducted a comparative DTI study of the arcuate fasciculus language pathway in humans, chimpanzees and rhesus macaques and has submitted this work to Science for publication. Dr. Shella Keilholz' group has visualized the laminar and columnar organization in rat olfactory bulb with DTI. These results suggest that DTI will prove a useful tool for studying changes in fine details of cortical structure following disease or during development. On a venture grant with Dr. Duong for improving DTI, the imaging core has provided segmented DTI sequences.

Dr. Jenny Yang's group at Georgia State University designed protein contrast agents with higher relaxivities by creating high coordination Gd3+ binding sites in a stable protein frame. The CBN imaging core has been collaborating with Dr. Yang in providing consultation and evaluating their contrast agents. A manuscript describing this work is under review by Nature Biotechnology.

Finally, MRI system operating program on our 9.4 T scanner is upgraded (to ParaVision 4.0). This upgrade provides us more measurement methods and analysis programs..It has significantly increased our ability to serve imaging users and benefit CBN investigators interested in using imaging in their studies.

***Behavioral Technology Core (BTC)*: Dr. Kim Wallen (EM) Head:** This core has been working extremely well in providing both service and technology development. The BTC is very active in setting up behavioral testing facilities and equipment at CBN institutions and will continue that function. The BTC is also committed to aiding in the collection of data about complex social behaviors through digital technology. The Behavior Tech core develops and distributes software for CBN participants and the larger academic community. In addition, it provides custom consulting to labs on best methods for solving behavioral data collection problems. It has the capacity to develop custom software and integrated hardware and software solutions. During the first seven years of funding it has developed over 10 software programs for use in behavioral experiments and is in the process of implementing an unattended system for distribution on the internet. Some examples include: **Stopwatch+** windows software that counts and times up to 16 behaviors simultaneously. It works best with single-subject observations. It is currently being used by more than 10 institutions outside of the CBN; **Obsummary** windows software that processes data files from The Observer 3.0-4.0. (Noldus Corp) Files exported from The Observer are not in a statistic-friendly format and require considerable time to reformat. Furthermore, the data files cannot be exported in The Observer without a hardware key. **Obsummary** processes the raw data files to produce statistics-friendly output files without the need for the hardware key. **HandObs** - palm application that allows the collection of event sequential data in real time with an elapsed time accurate to 0.001min attached to each behavioral line. The system is capable of collecting 10,000 lines of data, which are then easily transferred to a Windows PC. This is used by multiple CBN investigators, several outside institutions and also for education in observational methods with 120 undergraduate students at Emory per year. The BTC has had a primary focus on the last year in developing touchscreen kiosks for studies of

cognition in nonhuman primates. Some of these have been installed in a traditional laboratory setting for use by individual monkeys, but others have been installed near large social groups of monkeys who have rf ID tags implanted in their arms allowing them to "log on" to the kiosks and use them 24hrs per day. This represents a major advance in the manner in which cognition can be studied in primates. The rf ID technology has also been applied to a feeding preference study in Dr. Mark Wilson's lab supported by a venture grant in the Reproduction Collaboratory. This technology allows monkeys to choose between two different diets, automatically recording their ID and their consumption.

2c. Describe your research plan for the next reporting period with attention to any major upcoming changes in research direction or level of activity. Also, list plans for developing new research partnerships, if any, for the next reporting period.

The CBN's research plan will remain essentially the same in the next reporting period. We will continue to support collaborative research through our venture grant program and our collaboratory structure, which fosters interdisciplinary and inter-institutional interaction among our faculty and students. We will also continue to integrate this interdisciplinary, collaborative research with educational activities at all levels in order to train the next generation of researchers as interdisciplinary researchers who recognize the value of collaborative research. The research focus will continue to be on basic neuroscience research into complex behavior, particularly social behavior and its underlying emotional, regulatory, and cognitive processes. The CBN continues to build participation among researchers investigating fundamental cognitive and learning processes, as these are integral to the complex interaction of social behavior and the brain. The CBN is also currently moving a component of its activities into translational research and into more basic research in human neuroscience as we prepare ourselves strategically for funding opportunities post-NSF funding and to adhere to our knowledge transfer mission of bringing basic research knowledge to the applied fields and to the public. These are more evolutionary changes reflecting developments in the field of behavioral neuroscience rather than radical departures from the traditional goals of our Center.

In light of the challenges for the CBN after 2009, we have adjusted the Center's long-term strategic plan to meet the challenge of maintaining a vibrant Center when NSF funding ceases. The post-NSF administrative structure will allow the CBN to serve as a coordinator among the participating institutions, using the Georgia Research Alliance, a state agency responsible for state support for Georgia's research universities and colleges, as an administrative home receiving and distributing state and foundation support for CBN activities. We have also begun developing the establishment of an 'administrative core" for the CBN under the GSU VP-Research office that will serve to coordinate the CBN's intra- and inter-institutional activities. In essence, part of our long-term strategy is to serve as a coordinator for the institution-based programs that have emerged with CBN's help and which we hope will sustain CBN's legacy in research, education, and outreach. In addition, we have begun to coordinate with other centers at our participating institutions which focus on clinical or translational problems such as the Alzheimer's Center at Emory and the Sleep Research group within the Morehouse School of Medicine's Neuroscience Institute in order to link the basic research activities of the CBN with clinically related activities in other centers. Over the next year, we will be working within our existing partnership with the University of Illinois to establish a major inter-institutional program on the genomics of behavior. Our plan is to use the CBN's resources to establish points of mutual interest among faculty, then use venture grant and postdoctoral fellow support funds from the CBN in combination with similar support from these centers and research groups (primarily funding researchers who are members of both the CBN and the partner center or group) to stimulate collaborative research activities that will benefit both.

More details on this plans are detailed in "changes to strategic plan" section of this report.

III. EDUCATION

The overarching educational goal of the Center is to foster the next generation of behavioral neuroscientists. To this end, the CBN has implemented signature programs at the K-12, undergraduate, graduate, and postdoctoral levels to migrate students into research careers in behavioral neuroscience. This year marked the completion of the initial phase of evaluation of all the CBN educational programs, which will be ongoing as long as these programs continue. To date, results of the evaluation from a few of our programs have been published in science education journals (Zardetto-Smith, et.al., Cell Biology Education, 2006; Frantz et.al., Cell Biology Education, 2006).

At the K-12 level, we have partnered with the Atlanta Public School and Decatur City School systems and institutions of informal education (i.e., Fernbank Museum of Natural History and Zoo Atlanta) to develop enriching student- and teacher-centered programs that convey an excitement of science. During the Brain Awareness Month, scientists from the CBN visited over 140 K-12 classrooms around the Atlanta area to share their excitement about neuroscience. In April 2007, 160 middle school students toured the Neuroscience Exposition held at Zoo Atlanta, which provides a fun and informative introduction to neuroscience and behavior. Thirty high school students participated in the Brain Bee at the Fernbank Museum of Natural History, 10 high school students participated in our summer Institute on Neuroscience (ION) program, and 30 middle school students attended the Center's summer brain camp held at Renfroe Middle School, Decatur, Georgia. The Center also sponsored a professional development teacher workshop for 16 local middle and high school science teachers. All programs are held annually.

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. This year 27 undergraduates participated in the Center's formal research programs during the summer and academic year.

At the graduate level, the Center's collaborative approach to graduate training and its vast resources continues to thrive. Currently, 30 graduate students are supported financially by the Center. This year, one graduate course and 2 workshops were offered through the Center with an overall enrollment of 27 graduate students and five undergraduate students. In addition, 6 graduate scholars completed their graduate degrees this year and most have gone into very high profile neuroscience research laboratories.

Currently, 8 postdocs (5 women/1 minority) are being supported through the Center's postdoc fellowship program. Postdocs continue to benefit from the Center's wide resources including the collaboratories and cores where they gain broader training in techniques and research topics in their field. In addition, postdocs learn a valuable skill in collaborating on research projects.

Overall, the Center's pipeline approach is yielding promising results towards our objectives. The fact that students from across the nation are now applying to our programs indicates that the CBN has clearly become nationally recognized as a place for training in the neurosciences.

The main addition to the efforts summarized above include our efforts to seek and obtain new funding sources for our educational programs. This past year we submitted an IGERT preproposal grant which, although it was not recommended for a final proposal, it was recommended for revision and resubmission during the next funding cycle. Plans for the submission of other training grants are in progress, including the submission of an REU during the nexy funding cycle. Our new relationship with the local life science industry has opened the door to seeking some funds for training internships that will bring together the university and industry labs.

Importantly, most of the graduate training has already been institutionalized through the addition of new graduate programs and changes to existing programs that are the direct result of the CBN's efforts over the last eight years. Our efforts at Georgia State University have already been successful through the

establishment of the GSU "Brains and Behavior Program," which emulates CBN's structure of graduate student support for neuroscientists (and others) across campus, including one division that is essentially CBN members at GSU. We have begun to see a similar impact at Ga. Tech. Early on, CBN seeded a large computational neuroscience center at Ga. Tech. Which is now fully funded and supported by other grants. More recently, the addition of a new cognitive psychology training program promises to have overlap with CBN research and training, although it is unclear whether this will result in financial support that will directly impact the CBN. Although our efforts have expanded the behavioral neuroscience graduate training at Emory, our efforts to obtain institutional support from Emory University have not met with success so far. With new leadership at Emory, we have begun meetings with these leaders to enducate them about the center and how it has benefited Emory's research and education mission over the past either years. We hope that the new leadership at Emory will be more inclined to provide financial support on some level within the next year. The addition of two more behavioral neuroscientists at Morehouse School of Medicine in the past year has put MSM in the position of being able to begin a viable training program in neuroscience. Therefore, for the most part, we expect that most of the graduate and postdoctoral training and faculty research efforts will be or have been already institutionalized to varying degrees. Nonetheless, funding to support graduate students and postdocs that specifically work on collaborative projects across CBN faculty labs would help maintain the multi-institutional character of the CBN.

1a. Describe the Center's overall educational objectives, if they have changed since the previous reporting period. If the Center's overall educational objectives changed, how did they change and why?

The educational objectives of the Center have not changed from those stated in our initial strategic plan. These objectives include the following:

i. Create educational pathways to careers in behavior and neuroscience, with a special focus on minorities and women.
ii. Broaden career pathways beyond academic positions.
iii. Improve science education related to behavioral neuroscience at all grade levels.

1b. Inform us of the performance and management indicators the Center has developed to assess progress in meeting its education objectives, if changed from the previous reporting period.

i. Postdoctoral Program Goals:

The CBN fully funds up to eight postdoctoral fellows at a time for 2-year fellowships. In addition to supporting postdoctoral fellows, the CBN also has a number of postdoctoral members who work in CBN labs, but receive no direct financial support through the Fellows program. The Center provides resources through venture grants and access to workshops, seminars and other educational opportunities for postdoc members. One goal of the center's postdoctoral education program is to move more women and minorities into research faculty positions. Other goals focus on providing broad research training and career networking opportunities. We also strive to provide postdocs with access to alternative careers in neuroscience. Postdoc members in the CBN are eligible to apply for venture grant funds in order to complete pilot research that can be used to support grant applications for funding from other sources and to aid postdocs in developing their own line of research independent of their mentors. Specifically, the goals of the CBN Postdoctoral Program are:

Goal #1. To promote research collaboration within the Center through postdoctoral fellows who can act as conduits between laboratories.

Goal #2. To promote unique cross-disciplinary training for postdoctoral fellows through access to multiple

laboratories and technology cores
Goal #3. To provide unique training for postdoctoral fellows for grant-writing and for alternatives careers in neuroscience including teaching.
Goal #4. To provide opportunities for mentoring through the Center's graduate and undergraduate and high school programs.
Goal #5. To provide resources and training to promote independent research tracks for their careers in science.
Indicators: Percentage of women and/or minorities in CBN postdoc positions; Percentage of postdocs leaving the CBN for tenure-track research or teaching positions or other neuroscience-related careers.

ii. Graduate Program Goals:

The overall goals and format of the graduate program component have not changed. The Center has successfully focused its efforts on developing a comprehensive graduate training program that continues to offer its students expert training in behavioral neuroscience by a) offering inter-institutional courses that focus on the integration of neuroscience and behavior within the themes of the research thrusts of the Center and b) augmenting graduate training via involvement in collaboratory meetings, symposia, and hands-on workshops. Our graduate program provides full or supplemental support to attract students to behavioral neuroscience. All doctoral students enrolled in the participating graduate programs who are interested in the work of the collaboratories and/or cores are eligible for this support. Specifically, the goals of the CBN Graduate Program are as follows:
Goal #1. To attract and retain high quality graduate students interested in behavioral neuroscience, particularly minorities and women.
Goal #2. To provide these students with an integrative, inter-disciplinary experience using the diverse facilities of the CBN by orienting students to the CBN and its resources, fostering inter-institutional laboratory rotations or internships, and requiring inter-institutional participation on dissertation committees.
Indicators: Short-term indicators of success include time to completion for the doctorate; Retention rates for graduate students, particularly underrepresented minority students; Percentages of women and minorities matriculating at CBN-affiliated graduate programs; Level of student participation in inter-institutional courses, seminars, technical workshops and collaboratory meetings. Long-term indicators of the Center's impact include postdoctoral education and professional accomplishments (i.e. faculty appointments, publications, and innovations).

iii. Undergraduate Program Goals:

The main goal of the undergraduate program continues to be the cultivation of a cohort of undergraduates with a strong knowledge of behavioral neuroscience and motivation to pursue careers in behavioral neuroscience and other fields in which understanding of behavioral neuroscience would enrich science literacy for the public, such as science journalism, K-12 teaching, and public policy. Specifically, the goals of the undergraduate program are:
Goal #1. To attract an undergraduate population of underrepresented minority and female students to the field of behavioral neuroscience.
Goal #2. To provide an understanding of behavioral neuroscience for students choosing other careers.
Indicators: Increased numbers of students applying to CBN undergraduate programs and working in CBN labs; Increased numbers of these students graduating with a minor or major in neuroscience; Increased numbers of these students applying for and being accepted to neuroscience graduate programs; Percentages of minorities and women admitted into our undergraduate programs.

iv. External Program Goals (Pre-College and Public Education):

The overall goals of our pre-college and public initiatives have not changed. We have developed an array of successful programs, including formal teacher workshops, interactive student-centered activities focused on the brain, and formal laboratory immersions, which have created a collaborative community of learners consisting of public school educators, CBN faculty, postdocs, graduate fellows, and undergraduate students. These programs effectively address the primary goals of our external programs.

Goal #1. To entice students, especially underrepresented minority and female students, to explore neuroscience careers.

Goal #2. To integrate neuroscience into science curricula in Atlanta-area schools.

Goal #3. To enhance public awareness and understanding of CBN research.

Indicators: Increased numbers of applicants to pre-college activities (Brain Camps, ION, Brain Bee, Teacher workshops); Increased attendance by the general public to our public education events.

1c. Discuss any problems you may have encountered in making progress toward the Center's education goals during the reporting period as well as any problems anticipated in the next period. Include your plans for addressing these problems.

The Center has settled into a new education organizational structure nicely and we report no problems or concerns in this annual report regarding our educational mission and programs. Given that we are entering our ninth year of operation, our most anticipated problem in the immediate future is obtaining funds to maintain our programs in some form that will help us remain true to our original mission. Our efforts to obtain funding for these and other CBN programs are addressed in the Executive Summary.

2a. Describe the Center's <u>internal educational activities</u> in the reporting period. Include in the narrative a discussion of how the various internal education activities enable the Center to meet its goals.

Postdoctoral Fellowship Program:

Activity Name	Postdoctoral Fellowship Program and Postdoc Members
Led by	Associate Director and CBN faculty
Intended audience	Postdocs in CBN labs
# Participants	**7-year total:** 31 paid fellows (19 at Emory; 10 at GSU; 1 at Ga. Tech., 1 at Morris Brown College); 28 nonpaid postdoc members (17 at Emory; 9 at GSU; 1 at Spelman College, 1 at Morehouse College) **Current year total:** 8 paid fellows (5 at Emory; 3 at GSU); 13 nonpaid postdoc members (7 at Emory; 6 at GSU)
Alumnus information	Of the 58 postdoc fellows and members, 36 have moved into other positions: 17 tenure-track faculty; 2 research faculty; 1 non-tenured instructor; 4 are in second postdocs; 1 completing medical residency; 1 science journalist; 1 FBI scientist; 2 program officers at the CDC; 1 pursuing a degree in public health;

	6 changed careers paths or are currently on leave

The CBN has successfully recruited 31 CBN-paid postdoctoral fellows and 28 nonpaid postdoc members (i.e. supported by non-CBN funds) in eight years. Thirty-six 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 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.

Graduate Education:

The CBN's graduate education began with the CBN's Graduate Scholars program in 2001. Since that time, many other graduate students working in CBN-affiliated laboratories have expressed interest in being part of the CBN and therefore, we established a Graduate Student Membership status in 2004 which has 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, 70 students have matriculated through this program. This program is 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 provides a greater breadth of training and allows students to develop the skills for successful scientific collaboration. Students in this program are also 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.

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	**8-year total:** 70 graduate scholars (31 at Emory; 37 at GSU; 2 at Ga. Tech.); 27 non-paid graduate student members (15 at Emory, 9 at GSU, 3 at Ga. Tech.) **Current total:** 30 graduate scholars (13 at Emory; 16 at GSU; 1 at Ga. Tech); 24 graduate student members (13 at Emory, 8 at GSU, 3 at Ga. Tech.)
Alumnus information	Of the 70 total graduate scholars, 40 have moved on from the CBN: 19 are in research postdocs; 2 are tenure-track faculty (1 teaching and 1 research); 1 has a career in public health; 1 has a career as a science advisor to a law firm; 1 is in an MD residency program; 2 are completing their MD degrees as part of MD./Ph.D. program; 5 transferred out of the CBN-affiliated graduate programs into other graduate programs; 4 completed M.S. degrees and changed career paths; 5 left graduate programs before completing degrees and changed career paths.

Of the total of 70 graduate students who have matriculated through the Graduate Scholars program, 26 have successfully graduated with Ph.D.s. Twenty four of these Ph.D. graduates have gone into postdoctoral programs at major research institutions and 5 of these have already moved into other positions (tenure-track faculty, science advisor for law firm, public health career, MD resident). Currently there are 30 graduate students in the CBN Graduate Scholars Program and of those, 23 are females (77%) and 4 are minorities (13%). There are also currently 24 graduate student members of the CBN that include 19 females and 3 minorities.

Activity Name	Genes and Behavior (grad. course)
Led by	Drs. Bill Walthall (GSU) and Larry Young (Emory)
Intended audience	CBN graduate students
# Participants	11
Activity Name	Immunocytochemistry and in situ Hybridization Workshop
Led by	Dr. Gloria Hoffman, Univ. of Maryland
Intended audience	CBN graduate students and members
# Participants	60+ (includes 17 CBN grad. students)
Activity Name	Presentation Experiment Control Software Workshop
Led by	Dr. Robert Hampton
Intended audience	CBN graduate students
# Participants	9 CBN grad. students + 8 non-CBN grad. students

Graduate Scholars are required to take inter-institutional courses or workshops during their graduate career with the CBN. These are typically co-taught by faculty members in different disciplines or in different institutions. This past year we offered one course entitled "Genes and Behavior" and 2 workshops for our graduate students. In addition, our newly formed Graduate Student Association (GSA) has planned and is hosting a research retreat for all CBN graduate students in September 2007 that will promote scientific exchange and fellowship among all CBN graduate students.

Undergraduate Program:

The Undergraduate Education programs are designed to introduce undergraduates to the Center's research thrusts through in-class instruction, seminars, internships, research symposia, and collaboratory meetings. The Center faculty have played a major role in the development of new courses in behavioral neuroscience at most of our partner institutions and this year we have hosted 27 undergraduate students in our formal programs. We continue to promote a course consortium to allow our member institutions and their students to take advantage of classes offered at any of the member institutions. Our sixteen-page color brochure listing all undergraduate neuroscience classes and explaining how students can enroll continues to be widely distributed.

This year we successfully recruited our sixth cohort of undergraduate summer research interns (18) and expanded our target population to include an additional 3 interns funded by the Facilitating Academic Careers in Engineering and the Sciences (FACES) at Emory University. This brings the total number of students who have matriculated through the summer BRAIN program to over 280 for the last eight years.

Undergraduate Research Programs:

Activity Name	BRAIN (Behavioral Research Advancements in Neuroscience
Led by	Deputy Director for Education
Intended audience	Undergraduate students
# Participants	**7-year total:** 436 (>65% minority and >60% female); **Current total:** 21 students (52% minority and 66% female)
Activity Name	CBNuf (CBN undergraduate fellowships)
Led by	CBN faculty and postdocs
Intended audience	Undergraduate students
# Participants	6 (6 host labs) – (100% minority and 50% female)

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 includes 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 Face Book, 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. This year, recruitment events were hosted at three partner institutions (Emory, Morehouse College and Clark Atlanta University).

During the summer of 2007, a total of 21 students (66% women and 52% minority) participated in the BRAIN Undergraduate Research Program. Over 160 applications were submitted and this total was pared down to the accepted list via a rigorous review process carried out by members of the Undergraduate Education Committee, facilitated by the Undergraduate Education Program Coordinator. In the month preceding the BRAIN program opening, the Mentors participated in a Mentoring seminar to identify goals and mechanisms most appropriate for mentoring. This year mentors were asked to complete a mentoring plan and submit it to the Office for Undergraduate Education. The program began with a one week intensive orientation led by Dr., Erin Keen-Rhinehart (Yerkes, post-doc) and supported by GSU faculty lectures. Dr. Karama Neal, Senior Program Associate for Facilitating Academic Careers in Engineering and the Sciences (FACES/AGEP), assisted with BRAIN 2007 and secured support for an additional 3 interns. Fellows worked daily in research labs and met once a week on Thursdays for seminars designed to round out the research experience. Topics included: preparation for graduate school, bioethics, scientific entrepreneurship, and literature researching tools in the library. The summer program culminated with the Undergraduate Summer Research Symposium where each Fellow had the opportunity to present his/her research during a poster session and a closing luncheon.

Community of Young Neuroscientists (CoYN)

The Undergraduate Education Committee (UEC), comprised of the CBN Undergraduate Education Program Director, Undergraduate Education Program Coordinator, and CBN faculty from partner institutions, meets approximately once a month to discuss committee projects and concerns (i.e., BRAIN program development and intern selection; undergraduate education partnerships among institutions, and other undergraduate issues related to the CBN). Continuing from last year is 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 introductory event to establish the Community of Young Neuroscientists in late September of 2006 at Zoo Atlanta and will hold a similar event in the Fall of 2007. Undergraduates will have an opportunity to greet and mingle with CBN faculty, other undergraduates with similar interests, BRAIN alumni, as well as with students from the CBN Graduate Scholars and Post-Doctoral Fellows programs. The plan is to carry this out via a Fall Poster Symposium.

Center for Behavioral Neuroscience Undergraduate Fellows (CBNuf) Program

This program provided a hands-on research experience along with intensive instruction about the nature and process of scientific research. The program launched October 1, 2006 as a pilot with space for six undergraduate students. This program was limited to AUC undergraduate students who were enrolled full-time for the entire academic year. The CBNuf provided a stipend, money for research supplies and for student travel to present research at one meeting. Fellows were encouraged to explore opportunities to work in any of the 90+ CBN faculty labs throughout the CBN partner institutions. The CBNuf program was designed to pair students who have a strong interest in neuroscience with a research and scientific career mentor inside the CBN. Fellows spent a significant part of the beginning of the program learning about basic neuroscience research, ethics in research, and receiving general exposure to the CBN and its research mission. Following this initial phase, Fellows were paired with a research mentor and began the process of developing and implementing a research project. Fellows participated in CBN twice-monthly collaboratory meetings led by an Emory post-doc during the school year. The program culminated with a spring research colloquium where the 6 CBNuf students and 16 other undergraduate students presented posters. A qualitative analysis of the program showed very high success with the participants.

2b. Summarize the participation of Center students in professional development activities in the reporting period. Include in the narrative a discussion of how the various professional development activities enable the Center to meet its goals and produce meaningful results.

The primary mission of the education component of the Center is to develop the next generation of cross-trained, behavioral neuroscientists who possess excellent grant writing skills and an ability to effectively mentor. This year the CBN sponsored a workshop highlighting immunocytochemistry and in situ hybridization technologies for research open to all Center members including students. Over 60 people, including many students and faculty from the CBN, attended this workshop.

In addition, the CBN continues to sponsor annual seminars with invited speakers and one annual symposium featuring eminent scientists from a variety of areas of behavioral neuroscience. The seminars and symposium are largely attended by CBN faculty, post-docs, and graduate and undergraduate students, as well as non-CBN affiliated scientists, students, and teachers. This year the Center sponsored 2 seminars during the academic year. This is down from previous years because so many other affiliated department s are offering useful seminars in the field of behavioral neuroscience. The Center does not want to create redundancy and we see this as a good sign that the seminar series in behavioral neuroscience has already been institutionalized. Due to scheduling issues, our annual symposium, this year entitled "Genes and Behavior" has been moved to late fall 2007. This symposium will bring in eminent scientists in this field of research from around the world. These efforts help to increase the visibility of the center among the visiting scholars and within the local scientific community. In some cases, these efforts provide new relationships for scientific collaboration and potential training positions for students and faculty positions for postdocs.

2c. Describe the Center's external educational activities in the reporting period. Include in the

narrative a discussion of how the various external education activities enable the Center to meet its goals and produce meaningful results.

K-12 Educational Programs

Activity Name	Brain Bee
Led by	Deputy Director for Education
Intended audience	High school students
# Participants	**7-year total:** 225; **Current total:** 30
	(demographic data not collected)
Activity Name	Institute on Neuroscience
Led by	Dr. Kyle Frantz, CBN Science Educator
Intended audience	High school students
# Participants	**5-year total:** 45 (>40% minority and approx. 50% female); **Current total:** 10 (30% minority and 60% female)
Activity Name	Brains and Behavior Teacher Workshop
Led by	Dr. Laura Carruth, CBN Science Educator
Intended audience	K-12 science teachers
# Participants	**6-year total:** 189; **Current total:** 16
	(demographic data incomplete)
Activity Name	Summer Brain camp
Led by	Dr. Laura Carruth, CBN Science Educator
Intended audience	Rising 5th through 8th graders
# Participants	**6-year total:** 251 (approx. 50% minority and approx. 40% female); **Current total:** 30 (48% minority and 36% female)
Activity Name	Neuroscience Exposition Reverse Science Fair
Led by	Dr. Kyle Frantz, CBN Science Educator
Intended audience	Renfroe Middle School students
# Participants	**4-year total:** 550 (>75% minority); **Current total:** 160 (>45% minority) – no data on gender breakdown
Activity Name	Brain Awareness Month classroom visits
Led by	CBN members
Intended audience	K-12 students
# Participants	**7-year total:** 400+ classroom visits reached 10,000+ K-12 students **Current total:** 140 classrooms and reached 5000+ K-12 students

i. Brain Bee: The annual regional Brain Bee was once again co-sponsored by the CBN and the Fernbank Museum of Natural History, one of the center's community partner organizations. This year 30 students

from local and regional high school participated and the second place winner was sent with one parent to the national competition (the winner could not attend). 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 eleven students who participated in the Brain Bee apply for and participate in the ION program (see below).

ii. 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 2007, ten ION Scholars from metro Atlanta started and completed the program. Six scholars were women (60%), three scholars were under-represented minority students (African American; 30%) and four were Asian American (40%). These ten scholars were chosen from 28 applicants (75% female; 40% African American; 36% Asian; 29% Caucasian). The ION program is evaluated via three on-line assessments. Scholars complete Pre-, Mid-, and Post-Program Surveys that query their attitudes toward science, attitudes toward neuroscience, confidence with neuroscience concepts, and confidence with science-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 since 2003 kicked off this year with a focus group discussion in August 2007, to be followed by an on-line survey for all program alumni. The data from 2003 through 2007 will be culminated for submission to a science education research journal.

iii. 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 a one-week extended contact professional development workshop held at Zoo Atlanta from June 4th-9th 2007, for 16 K-12 Georgia science teachers (79% male, 36% minority). This teacher workshop requires extended contact and includes two single-day follow-up sessions in Nov. 2007 and March 2008. 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 will be visiting the classes of most of the teachers in the Fall of 2007 when they 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. The Dana Alliance for Brain Initiatives helped provide

materials for this workshop. 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.

iv. Brain Camps: This summer we offered one Brain Camp for middle school kids July 23rd-27th 2007 (8:30am-5:00pm) at Renfroe Middle School in the city of Decatur. We had 30 kids attend the camp (48% minority; 36% female). All students were from local schools, with 23 from the City Schools of Decatur. 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 second 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 five camp "counselors", teachers and neuroscientists from CBN institutions, who helped run 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.

v. Neuroscience Exposition (reverse science fair): The biggest event of Brain Awareness Month is our Neuroscience Exposition. This year the Expo featured over 30 interactive booths at which short neuroscience lessons engaged visitors 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 over 200 CBN faculty members, post-doctoral fellows, and students, as well as representatives of mental health advocacy groups and science education organizations. In 2007, 40 of these volunteers worked with K. Frantz (Expo Director) to earn internship credit at GSU for designing, implementing, and evaluating Expo booths. On the first day of this two-day event, all seventh-grade students from the City Schools of Decatur, Renfroe Middle School (n=160) 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. In 2007, we also visited classrooms before the 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). Preliminary data analysis indicate 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. This work suggests that in-school preparation enhances the impact of field trips. [In 2006, all students were from Charles Drew Charter School and were 99% of student participants were African American. The Charles Drew School did not commit to working with the CBN for this event in 2007. Therefore, the 2007 cohort came from City Schools of Decatur report 45% students from under-represented ethnic/racial groups (African American, Latino) students at their school.]

vi. K-12 Classroom Visits: Also during Brain Awareness month, the CBN partnered with the Atlanta Chapter of the Society for Neuroscience to lead over 140 classroom visits (up from 50 visits last year) to teach neuroscience in K-12 classrooms. Our estimates are that over 5000 students were reached in these school visits. Our primary objectives were to build on the success of previous years by continuing to increase the number of volunteers and the diversity and number of schools visited and to increase the availability and access to curriculum and visit planning materials. Because of the demand for school visits, we expanded these visits to extend through the end of the school year in order to fulfill as many request as

we could. Volunteers were paired with schools requesting visits and arranged with the schools what they would be presenting and when. Curriculum and visit planning materials were made available for volunteers though the ACSFN and Center for Behavioral Neuroscience websites and the CBN's Lending Library.

2d. Describe and discuss the ways in which the Center integrated research and education in the reporting period, with examples as appropriate.

We continue to support the integration of research and education in many different ways. Training for our postdocs and graduate students forms a centerpiece in these efforts. CBN graduate scholars and postdoctoral fellows are key links between research and educational efforts of the center, as they conduct a large amount of the sponsored research in our venture grant program and volunteer in many of our K-12 and undergraduate educational programs. Another example of integration of research and education is the hands-on research experience provided in center labs to undergraduate students where students learn abut neuroscience and skills for conducting research. We continue to see increased numbers of our students and faculty visiting K-12 classrooms to share their knowledge and excitement about neuroscience with these students. We also continue to sponsor educational projects through the venture grant program. This year we sponsored a new project with Zoo Atlanta that will bring neuroscience research to the public. A new interactive tree structure in the Zoo's orangutan exhibit that will house an touch-screen computer panel for cognitive research. CBN researchers are already collaborating with Zoo researchers on projects using this new tools at the Zoo, along with the gorilla training panel completed in 2006, to study cognition in two species (orangutans and gorillas) not currently available to CBN researchers at our academic institutions. The general public visiting to the Zoo get to observe the research process first-hand.

2e. Describe your plans for internal and external educational activities for the next reporting period with attention to any major changes in direction or level of activity. Also, list plans for developing new educational partnerships, if any, for the next reporting period.

Our main goals for the coming year will focus on seeking funds to support these programs after year 10 and the STC funds end. These efforts are underway and are outlined more clearly in the "changes to strategic plan" section of this report. Otherwise, our continued goals are to:

i. Goal #1: Create educational pathways to careers in behavior and neuroscience, with a special focus on minorities and women.

Objective: Increase overall student interest in studying behavioral neuroscience by providing experiential education opportunities for students at all levels, provide science curriculum enhancement at the pre-college and undergraduate levels, and conduct proactive recruitment activities at undergraduate level. We will continue with current educational initiatives at the pre-college, undergraduate, graduate, and post-doctoral levels and will continue teacher training and implementation of neuroscience in the pre-college curriculum.

Indicators: We will measure demographics and qualitative assessment of programs from participants as indicated by surveys and focus groups. Increase the number of students from center undergraduate programs applying to neuroscience or related graduate programs; Continue the successful placement of graduate students into quality postdoc positions and of postdocs into reputable career positions.

ii. Goal #2: Broaden career pathways beyond academic positions.

Objective: Promote an awareness of alternative careers in or related to behavioral neuroscience beyond that of the professoriate by providing information to students at all levels about careers in or related to behavioral neuroscience such as science policy, journalism, biotechnology, pre-college teaching, and

industry positions. We will provide career counseling and development as requested, aid students with guided career decision-making processes as requested, and, otherwise, promote the career services provided by partner institutions.
Indicators: Provide resources to students to equip them to make decisions about careers in or related to behavioral neuroscience.

iii. Goal #3: Improve science education related to behavioral neuroscience at all levels.
Objective #1: Promote behavioral neuroscience in K-12 curriculum in the local school systems by providing a number of programs and activities that target K-12 students and teachers to educate them in behavioral neuroscience. We will provide CBN sponsored K-12 teacher-training and workshops utilizing behavioral neuroscience material generated by CBN institutions and other sources; develop and provide behavioral neuroscience curricular materials that can be employed by Atlanta schools and other school systems nationwide; continue to provide hands-on science activities to K-12 students through Center activities and programs such as the Neuroscience Exposition, Brain Camps and the ION program.
Indicators: Increase the number of teachers applying for workshops and enhance use by these teachers of developed curricular materials; increase the number of local schools represented in Center programs for teachers and students of all ages (K-12); Increase attendance at or applications to all K-12 educational activities and programs.
Objective #2: Provide and promote opportunities to learn neuroscience at the undergraduate level.
Indicators: Help partner institutions provide quality neuroscience related courses to students; Maintain or increase number of students taking neuroscience related classes and conducting research in neuroscience labs.
Objective #3: Provide a high quality, multi-disciplinary graduate or postdoctoral education to the center's graduate students and postdocs. Create graduates and postdocs who are highly sought after for positions in neuroscience throughout the nation.
Indicators: Continue to attract new graduate students and postdocs to apply for CBN graduate and postdoctoral membership; Maintain quality career placement for graduating students and postdocs.

IV. KNOWLEDGE TRANSFER

1a and 1b. Describe the Center's overall knowledge transfer objectives, if they have changed since the previous reporting period. If the Center's overall knowledge transfer objectives changed, how did they change and why? Inform us of the performance and management indicators the Center has developed to assess progress in meeting its knowledge transfer objectives, if changed from previous reporting period.

The CBN knowledge transfer program, as outlined in our original proposal, focuses primarily on public education about behavioral neuroscience and has not changed since the CBN grant renewal. The Knowledge Transfer goals of the CBN for this reporting period were to:

i. Continue to make relevant Center activities accessible via our website and other technologies.
ii. Continue to increase public exposure and public appreciation of behavioral neuroscience.

Indicators: Growth in users, log-ins on website; Growth of quantity and quality of web resources for research and education; Impact of public exhibits and events (number of attendees, surveys responses); Substantial involvement of Center faculty and students in public science initiatives.

1c. Discuss any problems you have encountered in making progress towards the center's knowledge transfer goals during the reporting period as well as any problems anticipated in the next period. Include your plans for addressing these problems.

We continue to use standard assessment methods recommended and used by our community partners, including numbers of attendees and self-report surveys. We have had discussions with our community partners about other options for measuring impact of our public events, but these discussions have not provided useful alternatives to date. Importantly, these standard methods are the type typically employed nationally by organizations that conduct public education events.

2a. List organizations with which knowledge transfer occurs and the frequency and type of interactions. Describe the Center's knowledge transfer activities in the current reporting period and discuss how they enable the Center to meet its goals.

Partner organizations:
Zoo Atlanta
Fernbank Museum of Natural History
Atlanta Chapter of the Society for Neuroscience

Our partnerships with Zoo Atlanta and the Fernbank Museum of Natural History continue to provide vibrant examples of knowledge transfer to the general public. We have more recently established partnerships with Georgia Bio, a non-profit organization with the mission of brining more bioscience industry and workforce to Georgia. These partnerships have led us into some unique endeavors described below.

In partnership with Zoo Atlanta this year, 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. This and our previous exhibit enhancements are providing new ways of educating the public about gorilla and orangutan behavior and the importance of research in understanding their behavior. These exhibits also provide an important opportunity for the CBN to gain exposure to the public.

In the 6-year history of our annual Brain Fair: Neuroscience Exposition, we have reached over 12,000 members of the general public. This year's Neuroscience Exposition event was, once again, a tremendous success. Over 3500 people attended the Zoo on the date of the public EXPO and we estimate that most of those people participated in at least one or more of the activities that were presented by the Center. The event provided visitors the opportunity to visit over 30 interactive booths led by over 200 volunteers (including CBN graduate students, postdocs and faculty) on a number of topics including sensory perception, neurotransmission, and the effects of snake venom on the nervous system. This event also featured the grand opening of the new orangutan interactive panel with live demonstrations of orangutans working on the computer touch-screen along with a narrative by the trainers explaining the cognitive. Large crowds were gathered at many of the events scattered throughout the Zoo during the EXPO. Other learning opportunities included live demonstrations of animal behaviors throughout the Zoo.

The Center successfully continued it's "neuroscience in the movies" event with Fernbank Museum of Natural History that included the showing of two popular movies including "Iris," followed by a discussion of the neuroscience of Alzheimer's Disease as featured in the film led by Center scientist, Dr.

Allan Levey, and "A Beautiful Mind," followed by a discussion of the neuroscience of schizophrenia led by Dr. Elaine Walker of Emory University. These events are extremely well-received by the general public. As with our partnership with the Zoo, this provides the CBN with valuable public exposure while educating the public about human neuroscience.

The Fernbank Museum also serves as the location for the regional Brain Bee led by the CBN each year. This year we had 30 high school participants from local and regional schools. This event has become a useful service to local students who wish to participate in this event and provides visibility for both the CBN and Fernbank to those who attend and might not know about the center or the museum.

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 were able to put over 200 neuroscientists into more than 140 K-12 classrooms this year. These students are given a glimpse into the exciting world of neuroscience and we share information about our K-12 programs to which we invite the to apply. Our estimates are that more than 5000 K-12 students and teachers were reached through these visits.

2b. Describe any outcomes or impacts of knowledge transfer activities not listed above. Discuss, in particular, applications of Center research in industry, Federal laboratories or elsewhere not discussed above or elsewhere.

To assess our partnership activities we have measured numbers of attendees and used self-report surveys that have provided satisfactory evaluation for us and for our partners. In discussion with our partners, we are creating a strategy for obtaining sponsorships for these public events from local businesses interested in promoting neuroscience to the public. Using contacts that our community sponsors already have and those we have made during the past year, we will begin approaching potential sponsors this coming year and hope to secure funding for some or all of these events by the end of the coming year.

2c. Describe your plans for knowledge transfer activities for the next reporting period with attention to any major changes in direction of level of activity. Include plans for new knowledge transfer partnerships, if any.

We will continue our successful partnerships with the Zoo and the Fernbank Museum. Reproductive research continues with the pandas at Zoo Atlanta where the CBN provides technical analyses of the female panda's hormonal status. This will resume as soon as the female can be mated again. We will be looking for more unique ways to enhance other enhance other exhibits at the Zoo in the coming years. We will also continue to partner with the Fernbank Museum to host the annual Brain Bee competition for high school students and will sponsor other "neuroscience in the movies" events. We will continue growing our Brain Awareness Month classroom visitation program in partnership with the AC-SFN as we are able to manage. We have no additional Knowledge Transfer goals to add to those already mentioned above other than to begin seeking other sources of funding for some of these events and programs. Given the reduction in our funding, we will be transferring leadership of a few knowledge transfer activities to other entities (AC-SFN will assume Brain Bee and Neuroscience in the Movies events after 2009). We have no plans to expand unless or until other funds become available to do so.

V. EXTERNAL PARTNERSHIPS

1a. Partnership Objectives

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 for neuroscience training purposes, providing professional connections for graduate undergraduate, students and postdocs, promoting research and educational collaborations and to recruit great students and postdocs into our training programs and as potential faculty at our affiliated institutions.

1b. Problems

Although the GA BIO has very different objectives overall and methods of meeting those objectives than does the CBN, we have been able to find common ground and methods of meeting common objectives. Our exchange program partners provide a less problematic environment within which mutual goals of introducing scientists and promoting professional connections can be obtained.

2a. Activities

Partner Organizations:

Keck Center for Behavioral Biology, N.C. State University
Center for Intellectual Study of Animal Behavior, Indiana University
Georgia Bio

Our public educational activities with Zoo Atlanta and the Fernbank Museum are described above (see section IV Knowledge Transfer). We continue our successful relationship with the Keck Center for Behavioral Biology at N.C. State University, the Indiana University's CISAB. These exchange programs promote the exchange of scientific ideas among a broader community of scientists outside of the CBN and provide unique opportunities for our graduate students and postdocs to make connections with other scientists outside of Atlanta. The various collaborations between Center investigators and national and international scientists. Through these relationships, the CBN continues to develop an international reputation for behavioral neuroscience research.

Our partnership with Georgia Bio (formerly Georgia Biomedical Partnership) is focusing on bridging the biosciences and business in the academic environment at our partner institutions. This partnership is also providing 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 partnership with the Ga. Bio and 4 of our academic partner institutions, we are offering a new undergraduate course aimed at undergraduate students that will educate about the connection between bioscience and business. The course features CEOs from the local biosciences industry as the lecturers. The course brings together undergraduate science and business students from several of our partner institutions allowing them to form new connections with one another. Eventually we hope to introduce bioscience-business internships for students taking this course.

2b. Outcomes or Impacts

Assessment of the exchange programs with the Keck Center for Behavioral Biology (NC State) and the Indiana University's CISAB is limited to numbers and self reports, which are always positive. We continue to host graduate students and postdocs from the Keck Center and CISAB at our annual symposium and we send 2-3 of our students and postdocs to their annual retreats to share ideas and make professional connections. 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 one of our former postdoc members to a faculty position at N.C. State University.

The new undergraduate bioscience-business course has enrolled 24 students (both science and business majors) from four of our partner institutions. The course will run in the fall of 2007 with plans to possibly expand the course to the graduate level students in the coming year based on the interest we have already seen from our academic partners and the companies involved.

2c. Plans

We plan to continue working with our current partners in the capacity that we enjoyed in the past year and will look for unique ways to continue funding these partnerships after year 10 and the end of STC funds.

VI. DIVERSITY

1a. Describe the Center's overall objectives related to increasing diversity at the Center. If there have been any changes in the Center's overall objectives and plans related to increasing diversity since the last reporting period, discuss these changes and the reasons behind them. Inform us of the performance and management indicators the Center has developed to assess progress in meeting its diversity objectives.

Goal: From the beginning, the CBN has been committed to increasing the representation of minorities in neuroscience. The primary goal has been and remains to be reaching the following levels of women and minorities in the Center:

Indicators: 50% women and 20% minority faculty; 50% women and 25% minority postdocs; 50% women and 30% minority graduate student; 50% women and 30% minority undergraduate students.

The participating institutions planned to recruit at least 15 new faculty for the Center over the first five years and another 15 in the second 5 years, progressing towards our goal of at least 50% female and at least 20% minority faculty membership. Last year we brought the total of new faculty recruits by the Center to 32, including 14 (44%) women, four (13%) African-Americans, and one (3%) Native American. Overall, of the current 104 faculty members, 39 (39%) are female and 11 (10.5%) are minority (eight African American, two Hispanic, and one Native American). Of the current eight CBN-sponsored postdocs, four (50%) are female, and one (12.5%) is minority (Hispanic). Of the current 30 CBN graduate scholars, 23 (77%) are female and four (13%) are minority (three African American, one Hispanic). As in previous years, we again exceeded our goals for undergraduate minority and female recruitment with 23 (77%) females and 18 (67%) minority. Overall, we continue to move closer to meeting, and in some cases have surpassed, our goals for diversifying the graduate and undergraduate programs.

Table 1: Demographic breakdown of CBN members across institutions compared with ANDP averages for neuroscience (from 2003 ANDP survey of Neuroscience degree programs, the last completed survey, see: http://www.andp.org/surveys/surveys.htm).

	Total	Female (CBN)	Female (National)[1]	Underrep. Minority (CBN)	Underrep. Minority (National)[1]
Faculty	104	39 (39%)	25%/43%[2]	11 (10.5%)	3%
Postdoc Fellows	8	5 (63%)	42%	1 (12.5%)	8%

Grad Scholars	30	23 (77%)	50%	4 (13%)	12%
Undergrads	27	17 (63%)	n/a	18 (67%)	n/a

[1]From 2003 ADNP survey

[2]Tenure track/nontenure track faculty respectively; exact breakdown not reported for underrepresented minorities but stated as "equal"

1b. Discuss any problems you have encountered in making progress toward the Center's diversity goals during the reporting period as well as any problems anticipated in the next period. Include your plans for addressing these problems.

Our overall percentages for minorities, on some levels, continue to grow and in some instances have surpassed our original goals. Given the decrease in NSF funds this year and the next, it is unlikely that we will be able to recruit more faculty, postdocs or graduate students. However, we will continue to use the many other attractive resources of the CBN to attract new investigators at all levels as new Center members.

2a. Describe and discuss Center contributions to the development of United States human resources in science and engineering at the postdoctoral, graduate, undergraduate, and pre-college levels. Please pay particular attention to accomplishments and activities that aim to attract, increase, and retain the participation of US citizens, nationals, or lawfully admitted permanent resident aliens of the United States, women, underrepresented groups and persons with disabilities. Include a discussion of any partnerships formed which allow the Center to meet its diversity objectives.

As noted previously CBN uses 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 continue to educate K-12 children about neuroscience and behavior and expose them to related careers. Our outreach programs target schools in metro Atlanta where close to 50% of the students are minorities. At the undergraduate level, where many minorities and women primarily consider medical school, we are exposing 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.

2b. Discuss the impact of these programs or activities on enhancing diversity at the Center.

The level of diversity in the center has remained consistent over the past year. We continue 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 undergraduate programs remain highly diverse. We have also continued to attract female and minority graduate students into our participating graduate programs and have maintained high percentages of both in the center. We have seen less success in recruiting minority postdocs and minority faculty overall. 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 are already equal to or above the national averages for female and minority participation at the graduate, postdoc and faculty levels.

2c. Describe your plans for programs or activities to enhance diversity for the next reporting period with attention to any major changes in direction or level of activity. Be sure to discuss how the planned activities will enable the Center to meet its goals.
Goal: To continue to provide current graduate scholars and postdoc fellows already in the center with the best multi-disciplinary, collaborative training available in the field of behavioral neuroscience.
Indicators: We will continue to place students and postdocs in highly competitive and successful positions in both academic and non-academic organizations where they can continue to positively affect the field of behavioral neuroscience.

VII. MANAGEMENT

1a. Describe the Center's organizational strategy and its underlying rationale, if changed since the last reporting period. To assist in your description, attach the organization chart of the Center during the reporting period as Appendix B (if changed from the last period). If there have been any changes in the Center's organization or management since the last reporting period, discuss these changes and the reasons behind them.

No changes since the previous reporting period.

1b. Inform us of the performance and management indicators the Center has developed to assess its progress in organizational and management objectives, if changed from the previous reporting period.

No changes since the previous reporting period.

1c. Discuss any problems (eg. technical, personnel, communication) you may have encountered in realizing the Center's organizational strategy or management objectives in the reporting period as well as any problems anticipated in the next period. Include your plans for addressing any problems.

No changes since the previous reporting period.

2. Describe and discuss the management and communications systems being used to develop a fully integrated STC as well as any problems encountered in achieving this integration, if changed from the previous reporting period.

No changes since the previous reporting period.

3. Provide a list of names and affiliations of the Center's internal and external advisors or advisory bodies in the reporting period. Attach summary minutes of advisory committee meetings as Appendix C.

Name	Affiliation	Role
Etgen, Anne	Albert Einstein College of Medicine	External Advisory Board (EAB) Chair
Callaway, Thomas	Life Science Partner, Inc.	EAB member
Florant, Greg	Colorado State Univ.	EAB member
Kelley, Darcy	Columbia Univ.	EAB member
Massey, Christine	University of Pennsylvania	EAB member
McCarthy, Peg	University of Maryland	EAB member

Martinez, Joe	University of Texas, San Antonio	EAB member
McDonald, John	Kilpatrick and Stockton, LLP	EAB member
Pfaff, Don	Rockefeller University	EAB member
Ungerleider, Leslie	NIH	EAB member
Lewis, Earl	Provost, Emory University	Internal Advisory Board (IAB) member
Henry, Ron	Provost, Georgia State Univ.	IAB member
Liotta, Charles	Vice Provost, Ga. Tech.	IAB member
Harris-Hooker, Sandra	Assoc. Dir. Res., Morehouse School of Med	IAB member
Taylor, David	Provost, Morehouse College	IAB member
McNair, Lily	Assoc. Provost for Res., Spelman College	IAB member
Boggs, Olivia	Dir. Inst. Res., Morris Brown College	IAB member

4. Describe and discuss any changes to the Center's strategic plan since its last submission.
CBN is committed to maintaining itself as a multi-institutional research-education-community center. An assessment of our major strengths and threats (challenges) for the immediate future revealed the following key points:

- Strengths
  - Geographic proximity of partner institutions
  - Strong, cooperative relationships among partners
  - GSU commitment to housing CBN and its multi-institutional role
  - Strong relationship with GRA and Georgia Bio
  - Growing base of individual research and education grants
- Challenges
  - Funding for large programs difficult to obtain in current climate
  - Lack of control over member institutions' policies, goals, and degree programs
  - Time available to participating faculty

In response to this analysis, we will shift resources from expanding the CBN to supporting existing CBN members and programs, shift responsibility for institutional activities to the institutions and concentrate resources on most successful activities within each CBN area.

Specifically, in relation to our research mission we will focus spending on activities to support and enhance the existing CBN by protecting funding for venture grants and direct research support as first priority for STC funds while phasing out support for other activities. Support efforts within institutions for collaborative neuroscience research benefiting CBN members is already underway. Small "venture" type grants are available to GSU faculty in neuroscience through the new Brains and Behavior program. Also, Morehouse School of Medicine now has a critical mass of behavioral neuroscience researchers due to CBN support. We plan to concentrate our most immeidate efforts on obtaining new research funding for groups of CBN researchers across institutions. This includes the development of a "tool kit" of federal, foundation, and private sector (industry) support (Federal examples: Genomics of Social Behavior U54

"glue grant" in collaboration with University of Illinois, preproposal currently in preparation for 2008 deadline; Foundation example: Templeton Foundation: discussions underway; Industry example: Preliminary discussions with local pharmaceutical firms for venture grant support).

In relation to our higher education mission, planning has prepared for decrease in graduate and postdoc support through natural attrition without affecting currently supported students (but no new STC funded appointments). As STC funds decrease we will transfer responsibility for institutional programs to the institutions. For example, the graduate education in neuroscience at GSU is now institutionalized through the "Brains & Behavior" program. MSM Neuroscience Institute has now hired enough faculty in behavioral neuroscience to be poised to train graduate students in this area. Also, the graduate neuroscience program at Emory now has a major focus on behavioral neuroscience as a direct result of CBN activities. We will focus CBN STC support for undergraduate programs strategically in two areas over the final two years: Sustaining the BRAIN program at current levels and developing resources for undergraduates at member institutions. The later will occur through our continued efforts to develop a neuroscience undergraduate community and continued partnerships with existing undergraduate research programs at undergraduate institutions. Efforts to obtain funding for these programs are underway and include the development of a multi-institutional training grant proposal to supplement institutional support for graduate students and postdocs (IGERT preproposal submitted; declined; resubmission in planning stage), concentrating immediate efforts on obtaining new funding to support the summer BRAIN program (REU proposal in planning stage; plans for industry support near completion), and further development of partnerships with existing undergraduate research programs at member institutions and Agnes Scott College (providing access to training in CBN labs under CBN faculty mentors across institutions).

Our efforts in education at the K-12 level include focusing STC resources on four highest impact programs: ION, Brain Camp, Teacher Workshop Program, Brain Expo. We will use the past 3 years of assessment data to critically evaluate programs and determine best strategy for sustained funding. We will also begin a phased transfer of responsibility to other entities for other, more minor programs (Brain Bee, Neuroscience Movie Nights, etc.). Efforts to make ION, Brain Camps, Teacher Workshop Program, Brain Expo self-sustaining via grants, industry support, and fees are already underway. Through our ongoing relationship with the Dana Alliance future formal proposals for funding are in process. Applications for Georgia state education funds continuing. We have developed materials to support approaches to private sector for program support. Federal applications planned for 2009 (SEPA) and beyond (NSF) and an application to ACNP submitted for funding for the Neuroscience EXPO for 2008. The Brain Bee and Neuroscience movie events are now in collaboration with Atlanta Chapter of Society for Neuroscience which will assume leadership for these events after 2009.

Our plans for our knowledge transfer activities are included in most of the above descriptions as our Knowledge Transfer is clearly integrated into our research (i.e. exhibit enhancements for research at Zoo Atlanta) and education (i.e. Neuroscience EXPO, Neuroscience movie events) missions.

Perhaps the most important aspect of our transition in the final two years of STC funding involve obtaining institutional commitments necessary to maintain administration of the Center. STC contribution to administration will decrease at least in proportion to phased budget reduction. GSU has made the commitment to ramp up administrative support levels as STC funding ramps down. GSU's commitment for CBN administrative functions extends beyond year 10 and the end of STC funding. Plans to locate CBN administrative functions within the VP-Research Office at GSU has been approved in principle. Contribution by Georgia Research Alliance (GRA) to CBN for research support is expected to continue beyond year 10 and the end of STC funding. In addition, GRA has formed a nonprofit foundation 501c3 arm of the CBN under its offices to facilitate acquisition and distribution of external funds to all CBN institutional members. Therefore, barring changes in situation at other institutions, after year 10

administrative location of CBN will be centered at GSU. Although CBN will remain a multi-institutional center via cooperative agreements, faculty membership, and multi-institutional education initiatives, it remains critical to obtain institutional support for the Center beyond year 10 from all partner institutions to ensure the true multi-institutional nature of the center. Discussions for institutional support are underway at Emory, but no commitment has been obtained as yet. We will be approaching all other partner institutions in the coming year to obtain similar commitments as possible.

VIII. CENTER WIDE OUTPUTS AND ISSUES

1a. List all Center publications in the reporting period using a standard citation format.
(due to the large number of publications, we are attaching these as an new Appendix E)

Year	#Faculty	# Publications	# w/multi-labs-not CBN	# w/multi-CBN labs	# CBN funded
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

1b. 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 as an new Appendix E)

Year	#Faculty	#Presentations	# w/multi-labs-not CBN	# w/multi-CBN labs	# CBN funded
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			

1c. Briefly describe any other dissemination activities not included elsewhere in the report.

Grants seeded by Center funds (2006-2007)
Dr. Page Anderson
Anxiety Disorders Association of America, 04/01/2007

Dr. Jocelyne Bachevalier
NIMH, 09/01/2007 to 08/31/2010
NIMH, 7/1/2008 to 06/30/2013
Dr. Tim Bartness
NIH, 03/15/2007 to 03/14/2011
Dr. Laura Carruth
National Science Foundation, 9/1/2007 to 9/30/2010
Dr. Joanne Chu
NSF, 09/01/2006 to 08/31/2008
Dr. Charles Derby
NSF, 08/15/2006 to 08/15/2009
Naval Surface Warfare Center, 1/16/2007 to 1/15/2008
Dr. Steve DeWeerth
NIH, 02/01/2007 to 01/31/2011
Dr. Donald Edwards
NSF, 04/15/2007 to 03/31/2011
Dr. Kyle Frantz
American College on Neuropharmacology (ACNP), 01/01/2007 to 12/31/2007
Society for Neuroscience, 10/01/2006
Georgia State University, 01/01/2007 to 12/31/2007
Dr. Robert Hampton
James S. McDonnell Foundation, 09/01/2006 to 08/31/2009
Dr. Xiaoping Hu
NICHD, 04/01/2007 to 03/31/2009
NCI, 4/1/2007 to 03/30/2012
Georgia Research Alliance, 03/01/2007 to 06/30/2008
Dr. Donna Maney
NSF, 06/01/2006 to 08/31/2006
NSF, 09/01/2007 to 08/31/2011
Dr. Helen Mayberg
Stanley Medical Research Foundation, 9/1/2006 to 8/31/2009
Woodruff Fund, 09/01/2006 to 08/31/2008
NIMH, 09/01/2006 to 08/31/2011
Dr. Erin McClure
Anxiety Disorders Assoc. of America, 04/01/2007
Dr. Tim Moore
United Negro College Fund/Henry C. McBay Research Fellowship, 9/1/2007 to 6/30/2008
Dr. Todd Preuss
NIH, 05/01/2007 to 04/30/2012
National Institute of Aging/NIH, 1/15/2007 to 1/14/2012
National Institute of Deafness and Communicative Disorders/NIH, 1/15/2007 to 1/14/2012
Dr. Mar Sanchez
National Institute of Child Development (NIH/NICHD), 4/1/0007 to 3/31/2009
National Institute of Mental Health (NIH/NIMH), 12/1/2007 to 11/30/2012
Dr. John Scott
NIDCD, 7/1/2007 to 6/30/2012

Dr. Kathy Stansbury
DOE/DHHS, 09/01/2007
Dr. Larry Young
Autism Speaks, 7/1/2007 to 6/30/2009

Postdoctoral

Dr. Anne-Pierre Goursaud
NIMH-R03, 04/01/2006 to 01/31/2008

2. List all awards and other honors with names of those honored and source in the reporting period.

Dr. Maria Alvarado
Vulcan Materials Award for Teaching Excellence, Spelman College, 2006
Dr. Page Anderson
Junior Faaculty Research Award, Anxiety Disorders Association of America, 2007
Dr. Jocelyne Bachevalier
Fellow, Association for Psychological Sciences (APS), 2007
Dr. Timothy J. Bartness
Alfred Nobel Lecturer, Goteborg, Sweden, 2006
Outstanding Faculty Scholarship Award, College of Arts and Sciences, GSU, 2006
Dr. Larry Blumer
Teaching Excellence Award at Morehouse College, Vulcan Materials Company and Georgia Foundation for Independent Colleges, 2007
Dr. Laura Carruth
Education Fellow in the Life Sciences, National Academy of Sciences, 2006
Dr. Michael Davis
Distinguished Scientific Contributions Award, American Psychological Association, 2006
The Pavlovian Research Award, Pavlovian Society, 2006
Dr. Steve DeWeerth
Fellow, Am. Inst. for Medical and Biological Engineering, 2006
Dr. David Edwards
Crystal Apple Award for Excellence in Undergraduate Lecture Education, Emory University, 2007
Dr. Bill Fantegrossi
Early Career Award, College on Problems of Drug Dependence, 2006
Dr. Byron Ford
Dean's Award for Outstanding Researcher, Morehouse School of Medicine, 2006
Morehouse School of Medicine Dean's Award for Outstanding Researcher, Moreshouse School of Medicine, 2006
Dr. Kyle Frantz
Outstanding Junior Faculty Award, GSU, 2007
Georgia State University College of Arts and Sciences Outstanding Junior Faculty Award, GSU, 2007
Cold Spring Harbor Course Scholarship: Cell Biology of Addiction, 2007
Next Generation Junior Faculty Award, Society for Neuroscience Award, 2007
Dr. Christine Heim
Curt Richter Award, International Society for Psychoneuroendocrinology, 2007
Dr. Julia Kubanek
Georgia Tech, Hesburgh Teaching Award Fellowship, 2006

Dr. Hang Lu
Young Professor Award, DuPont, 2006
DARPA Young Faculty Award, 2007
Dr. Gretchen Neigh
International Neuroendocrine Travel Award, 2006
American College of Neuropsychopharmacology Young Investigator Memorial Travel Award, 2006
Summer Research Institute in Geriatric Psychiatry, NIH, 2007
Dr. Erin McClure
Junior Faculty Award, Anxiety Disorders Association of America, 2007
Dr. Andrew Miller
Norman Cousins Award, Soc. of Psychoneuroimmunology, June 2007
Dr. Paul Plotsky
Plenary Lectureship Award, British Association of Pharmacology, 2006
Dr. Todd Preuss
Kavli Frontiers of Science Fellow, National Academy of Sciences, 2006
Kavli Frontiers of Science Fellow, National Academy of Sciences, 2007
Dr. Kerry Ressler
Translational Clinical Scientist Award, Burroughs Wellcome Foundation, 2006
Dr. Gianluca Tosini
Graduate Faculty Award, Morehouse School of Medicine, 2007
Copernicus Visiting Scientist, University of Ferrara, IT, 2008
Dr. Binghe Wang
Alumni Distinguished Professor Award, GSU, 2007
Outstanding Faculty Scholarship Award, GSU, 2007
Dr. Mark Wilson
Woodruff Leadership Academy Fellow, Robert Woodruff Foundation, 2006
Dr. Stuart M Zola
Harry Middleton Award, 2006
Finalist for Atlanta Business Chronicle's Health Care Heroes Award, Atlanta Business Chronicle, 2006

Postdoctoral:

Dr. Beate Ditzen
Early Career Award, Intl. Congress of the Soc. for Behavioral Medicine, 2006
Research and Travel Award, Swiss Science Foundation, 2007
Dr. Anne-Pierre Goursaud
Travel Award, Int. Soc. for Developmental Psychobiology, 2006
Travel Award – Annual Wisconsin Symposium on Emotion, April 2007

3. List any undergraduate, 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
Cooper, Matthew	Postdoc	N/A	Asst. Professor, UT-Knoxville

Martin-Malivel	Postdoc	N/A	Non-tenured Researcher, Mediterranean Univ., Marseille, France
Nair, Hemainth	Postdoc	N/A	Epidemic Intelligence Officer, CDC
Felger, Jennifer	Grad.	5	Postdoc at Rockefeller Univ.
Gutman, Alisa	Grad.	5.5	Completing MD at Emory Univ.
Jones, Seth	Grad.	6	Postdoc at UT-Dallas
Pulliam, John	Grad.	6	Postdoc at Morehouse Sch. Medicine
Rodgers, Edmund	Grad.	6	Postdoc at Univ. Maryland
Scrivens, Jevin	Grad.	6	Postdoc at Emory Univ.
Spitzer, Nadja	Grad.	5	Postdoc at Marshall Univ.

4a. List, to the extent known, the general outputs of knowledge transfer activities since the last reporting period.

Patent Name and Inventors	Number	Application Date	Receipt Date
Magnetic resonance eye tracking systems and methods; Xiaoping Hu		4/2007	Pending
ABC Transporter Ligand; Julia Kubanek		5/2007	Pending
CLC Channel Ligand; Julia Kubanek		7/2007	Pending
No license agreements			

4b. Describe any other outputs of knowledge transfer activities made during the reporting period not listed above.

No changes since previous reporting period.

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.

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.
Balch, Tucker	College of Computing, Ga. Tech.	M	Caucasian	None	U.S.
Bartness, Tim	Biology, GSU	M	Caucasian	None	U.S.
Blumer, Larry	Biology, Morehouse College	M	Caucasian	None	U.S.
Bradley, Dolores	Psych, Spelman	F	African Amer	None	U.S.
Brummer, Marijn	Radiology, Emory	M	Caucasian	None	U.S.
Buffalo, Elizabeth	Neurology, Emory	F	Caucasian	None	U.S.
Butera, Robert	Elec. Computer Engineering,	M	Caucasian	None	U.S.

	Ga. Tech				
Carruth, Laura	Biology, GSU	F	Native Amer	None	U.S.
Chu, Joanne	Biology, Spelman	F	Asian Amer	None	U.S.
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.
Duncan, Erica	Psychiatry, Emory	F	Caucasian	None	U.S.
Duong, Tim	Neurology, Emory	M	Asian Amer	None	U.S.
Edwards, David	Psych, Emory	M	Caucasian	None	U.S.
Edwards, Don	Biology, GSU	M	Caucasian	None	U.S.
Fantegrossi, Bill	Yerkes, Emory	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.
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.

Maestripieri, Dario	Univ. Chicago	M	Caucasian	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.
Neill, Darryl	Psych, Emory	M	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.
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.
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.
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.
Snyder, Rebecca	Zoo Atlanta	F	Caucasian	None	U.S.
Stahl, Jeanne	No affiliation	F	Caucasian	None	U.S.
Stansbury, Kathy	Psych, Morehouse College	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.

Vanman, Eric	Psych, GSU	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.
Wang, Binghe	Chemistry, GSU	M	Asian	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.
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.
Yen, Jeannette	Biology, Ga. Tech.	F	Asian Amer	None	U.S.
Young, Larry	Psychiatry, Emory	M	Caucasian	None	U.S.
Zola, Stuart	Yerkes, Emory	M	Caucasian	None	U.S.

POSTDOCS

Name	**Dept. and Institution**	**Gender**	**Ethnicity/Race**	**Disability**	**Citizenship**
Adachi, Ikuma	Psych, Emory	M	Asian	None	Non-citizen
Antonsen, Brian	Biology, GSU	M	Caucasian	None	U.S.
Black, Michael	Psych, GSU	M	Caucasian	None	U.S.
Calhoun, Rose	Yerkes, Emory	F	Caucasian	None	U.S.
Calin-Jageman, Robert	Biology, GSU	M	Caucasian	None	U.S.
Choi, Dennis	Psychiatry, Emory	M	Asian Amer	None	U.S.
Cooper, Matthew	Psych, GSU	M	Caucasian	None	U.S.
Daftary-Brussiere, Shabrine	Yerkes, Emory	F	Caucasian	None	U.S.
Ditzen, Beate	Psychiatry, Emory	F	Caucasian	None	Non-citizen
Goursaud, Anne-Pierre	Psych, Emory	F	Caucasian	None	Non-citizen
Heldt, Scott	Psychiatry, Emory	M	Caucasian	None	U.S.
Hoffman, Jackie	Yerkes, Emory	F	Caucasian	None	Non-citizen
Hummer, Daniel	Biology, GSU	M	Caucasian	None	U.S.
Jasnow, Aaron	Psychiatry, Emory	M	Caucasian	None	U.S.
Jiminez, Pedro	Biology, GSU	M	Hispanic	None	Non-citizen
Kamio, Michiya	Biology, GSU	M	Asian	None	Non-citizen
Keen-Rhinehart, Erin	Yerkes, Emory	F	Caucasian	None	U.S.
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.
Martin-Malivel, Julie	Psych, Emory	F	Caucasian	None	Non-citizen
McGraw, Lisa	Psychiatry, Emory	F	Caucasian	None	U.S.
Myers, Karyn	Psychiatry, Emory	F	Caucasian	None	U.S.
Nair, Hemu	Psychiatry, Emory	M	Asian Amer	None	U.S.
Neigh, Gretchen	Psychiatry, Emory	F	Cauicasian	None	U.S.
Nguyen, Mary	Biology, GSU	F	Asian Amer	None	U.S.
Rozga, Agata	Psychology, GSU	F	Caucasian	None	U.S.
Song, Kay	Psych, GSU	F	Asian	None	Perm. Res.
Spitzer, Nadja	Biology, GSU	F	Caucasian	None	Perm. Res.
Toufexis, Donna	Psychiatry, Emory	F	Caucasian	None	Perm. Res.
Vrailis, Alysia	Cell Biol, Emory	F	Caucasian	None	U.S.

GRADUATE STUDENTS

Name	**Dept. and Institution**	**Gender**	**Ethnicity/Race**	**Disability**	**Citizenship**
Ahern, Todd	Psych, GSU	M	Caucasian	None	U.S.
Amoss, Toby	Neuroscience, Emory	M	Caucasian	None	U.S.
Bakkum, Doug	Biomed. Eng., Ga. Tech.	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.
Colunga, Vincent	Biology, GSU	M	Hispanic	None	U.S.
Dailey, Megan	Biology, GSU	F	Caucasian	None	U.S.
Doherty, James	Biology, GSU	M	Caucasian	None	U.S.
Donaldson, Zoe	Neuroscience, Emory	F	Caucasian	None	U.S.
Duncan, Kelli	Biology, GSU	F	African Amer	None	U.S.
Fugate, Jennifer	Psych, Emory	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.
Hassett, Janice	Psych, 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.
Leung, Cary	Psych, Emory	F	Asian Amer	None	U.S.
Lillvis, Joshua	Biology, GSU	M	Caucasian	None	U.S.
Lin, Stacie	Psych, GSU	F	Asian Amer	None	U.S.
Lorenzi, Varenka	Biology, GSU	F	Caucasian	None	Non-citizen
Loyd, Dayna	Biology, GSU	F	Caucasian	None	U.S.
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.
Michopoulos, Vasiliki	Neuroscience, Emory	F	Caucasian	None	Non-citizen
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.
Paxton, Regina	Psych, Emory	F	Caucasian	None	U.S.
Payne, Christa	Psych, Emory	F	Caucasian	None	U.S.
Philipp. Michael	Psych, 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.
Schwarb, Hillary	Psych, Ga. Tech.	F	Caucasian	None	U.S.
Shabani, Shelzan	Biology, GSU	M	Caucasian	None	Perm. Res.
Shahbazi, Mahin	Biology, GSU	F	Caucasian	None	U.S.
Stephens, Shannon	Psych, Emory	F	Caucasian	None	U.S.
Taylor, Nicole	Anthropology, Emory	F	Caucasian	None	Non-citizen
Vytal, Katye	Psych, Emory	F	Caucasian	None	U.S.
Watts, Kelly	Neuroscience, Emory	F	Caucasian	None	U.S.
Wheeler, Marina	Psychology, Emory	F	Caucasian	None	U.S.
Zeamer, Alyson	Psychology, Emory	F	Caucasian	None	U.S.

6. Provide a summary listing of all of the Center's research, education, knowledge transfer and other institutional partners (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
Fernbank Museum of Natural History	Museum	Atlanta, GA	Susan Neugent, Pres.	K.T. and education	N
Atlanta Chapter of the Society for Neuroscience	Non-profit	Atlanta, GA	Paul Katz, Pres.	Education and Research	N
Georgia Bio	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	Education	N
CISAB, Univ. of Indiana	University	Bloomington, Ill	Linda Summers	Education	N

7. For internal NSF reporting purposes, provide a Summary Table 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)	$88,674,960
The number of participants	179 (+27 undergrads)

8. Describe and media publicity the Center received in the reporting period. Provide in <u>Appendix D</u> 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>

11/7/06	MSNBC.com, Reuters.com, Ninemsn.com, Yahoo! News, ScienceDirect.com, current-biology.com	Jet-lagged mice die young, study finds	Alec Davidson	Hard copy
11/8/06	CNN Explorer Series (TV)	Obesity research	Tim Bartness	http://db.cbn.gsu.edu/qtmedia/CNN-TB2.mov
11/9/06	Yerkes National Primate Research Center website, *Medical News Today*	Yerkes researchers pave the way for earlier diagnosis and treatment of retinal degenerative diseases	Timothy Duong	http://www.medicalnewstoday.com/articles/56055.php

10/24/06	bbc.co.uk Science & Nature (TV), *Discover*	Brain in a Dish	Steve Potter	http://www.bbc.co.uk/sn/tvradio/programmes/horizon/broadband/tx/singularity/potters_brain/
12/15/06	AJC, Zooatlanta.org, Oxfordpress.com	Panda pregnancy took careful planning	Elliott Albers	Hard copy
12/20/06	Georgia State University website	Make Nice or Else	Donald Edwards	http://www.gsu.edu/22195.html
3/6/07	Georgia Institute of Technology website	For easy tasks, brain preps and decides together	Eric Schumacher	http://www.gatech.edu/news-room/release.php?id=1292
3/30/07	*Creative Loafing.com*	IRIS (Movie @ Fernbank Museum)		http://atlanta.creativeloafing/gyrobase/Content?category=oid%3A54
4/5/07	Georgia State University website	Neuroscientists break out of labs, head to Zoo Atlanta for annual Brain Expo	General CBN	http://www2.gsu.edu/~wwwexa/news/archive/general/07_0405-brain.htm
4/10/07	NYTimes.com	Birds Do It. Bees Do It. People Seek the Keys to It.	Kim Wallen	http://www.nytimes.com/2007/04/10/science/10desi.html?ex=1333857600&en=710c65da2da8c795&ei=5088&partner=rssnyt&emc=rss
4/12/07	ajc.com, Yerkes National Primate Research Center website	Sex and prenatal hormone exposure affect cognitive performance, Yerkes scientists find	Kim Wallen, Rebecca Herman	http://www.yerkes.emory.edu/index/yerkes-app/story.73/title.sex-and-prenatal-hormone-exposure-affect-cognitive-performance-yerkes-scientists-find

4/12/07	ajc.com, zeenews.com, Emory University website	Research shows men and women look at sexual photographs differently	Kim Wallen, Heather Rupp	Hard copy
Spring 2007	*Georgia State Magazine*	Mind Control: Drawing a Better Diagram of the Human Brain	Paul Katz	Hard copy
5/7/07	ajc.com, *Georgia State Magazine*, CreativeLoafing.com	Giant brain over downtown signals way to smart events	General CBN	Hard copy; Photo
6/12/07	Emory Health News, innovations-report.com, *Science Daily,* NewScientist.com	Mother mice more attuned to pup sounds than others	Robert Liu	Hard copy
7/2/07	China Tribune, GSU Arts and Sciences website	CBN hosts prestigious Chinese delegation	Elliott Albers	Hard copy
Jul-07	AJC.com, The Federation (online newsletter), GSU Arts and Sciences Website, HealthNewsDigest.com	Virtual Iraq	Elliott Albers	Hard copy

IX. INDIRECT/OTHER IMPACTS

1. Venture Grants awarded during reporting period to Center members
May 2007:
PIs: Jocelyne Bachevalier, Stuart Zola
Neural substrates of cross-modal integration of socio-emotional cues: a PET imaging study in nonhuman primates (MEMORY AND COGNITION)

PIs: Michael Black, Walt Wilczynski, Kerry Ressler

Molecular Mechanisms for Status Memory (COGNITION AND MEMORY, AGGRESSION AND FEAR)

PIs: Mike Davis, Larry Young
Development of a Method for Selectively Lesioning Discrete Nuclei Within the Central Nucleus of the Amygdala (AFFILIAITON AND FEAR)

PIs: Christine Heim, Beate Ditzen, Helen Mayberg, Kerry Ressler, Larry Young
Impact of Early Adversity on the CNS Oxytocin System: Relevance for Psychopathology (AFFILIATION, REPRODUCTION, FEAR)

PIs: Ketema Paul, Laura Carruth
The Role of Genetic Sex and Prolactin in Organizing Sleep Responses to Stress (REPRODUCTION AND SEX DIFFERENCES)

PIs: Kai McCormack, Mark Wilson
Affiliative behavior in rhesus macaques: A multi-method approach (AFFILIATION)

Dec 2006:
PIs: Robert Calin-Jageman, Paul S. Katz, Kyle Frantz.
Development of an invertebrate system for studying drug reinforcement.
(AGGRESSION, REWARD AND REINFORCEMENT)

PIs: Beate Ditzen, Larry Young, Kim Wallen.
Effects of menstrual cycle phase and intranasal oxytocin on gaze duration and focus in women viewing pictures of erotic and attachment content. (AFFILIATION, REPRODUCTION)

PIs: Duane Jackson, Michael Goodisman.
Searching for the genetic basis of Aggression in Termites (*Reticulitermes sp)*and developing techniques and teaching module for the behavioral sciences. (AGGRESSION)

PIs: Donna Maney, Larry Young, James Thomas.
Genetic and neuroendocrine bases of behavioral polymorphism. (AFFILIATION)

PIs: Lisa Parr, Stuart Zola.
An examination of evolutionary specializations into auditory memory. (COGNITION AND MEMORY)

2. CBN events in 2006-2007

October 12 – 18th – CBN at the Society for Neuroscience Meeting in Atlanta, GA
October 12th – SFN Satellite Meeting
Symposium on Advances in Drug Abuse Research
Emory University

October 13th - SFN Satellite Meeting
Oxytocin, Vasopressin and Emotional Regulation: New Frontiers in Basic Neuroscience and Translational Opportunities

Loudermilk Center, Downtown Atlanta

October 14th - BRAIN BALLOON (nine-story brain-shaped hit air balloon)
Interactive science booths and fun
Georgia State University, Downtown Atlanta

October 15 – 18th – CBN Exhibit Booth

November 15th – CBN Seminar
Jeff Blaustein, Ph.D., Professor, Dept. of Psychology, Center for Neuroendocrine Studies; Neuroscience and Behavior Program, University of Massachusetts
"Hormones and behavior without the hormones: influences of the social environment on steroid hormone receptors"

February 3rd – CBN Annual Regional Brain Bee Competition
Fernbank Museum of Natural History

February 27, 2007 - CBN Seminar
Tyrone Hayes, Ph.D., Assistant Professor, University of California at Berkeley
"From Silent Spring To Silent Night:
Endocrine Disrupting Pesticides, Amphibian Declines, and Cancer"

April 3rd – CBN Neuroscience in the Movies (featured film: Iris)
Allan, Levey, MD, Ph.D., Professor of Neurology,
Director, Alzheimer's Disease Center, Emory University
Fernbank Museum of Natural History
"A Portrait of Alzheimer's Disease"

April 13-14th – Neuroscience Exposition
Saturday, April 14th was open to public and CBN members.
Zoo Atlanta

April 24th – CBN Undergraduate Research Symposium
Research presentations by CBNuf and other undergraduate students
Zoo Atlanta

April 26th – CBN Immunocytochemistry and in situ Hybridization Workshop
Gloria Hoffman, Ph.D., Dept. of Aantomy and Neurobiology, University of Maryland

May 30 – June 6th – CBN Workshop on Presentation© Experiment Control Software
Robert Hampton, Ph.D., Ikuma Adachi, Ph.D. and Ben Basile, instructors

June 4-8th – Why They Do What They Do at the Zoo: Animal Behavior and the Brain
Middle and high school teacher professional training workshop

July 26th – BRAIN Program Research Poster Review

Poster presentations by participants

July 23 - 27th – Brain Camp
July 27th Open House - Scientific demonstrations by participants

August 3rd – Institute on Neuroscience Closing Ceremony
Research presentations by participants

September 19th – CBN Seminar
Courtney DeVries, Ph.D., Associate Professor of Psychology and Neuroscience, The Ohio State University
"Social Influences on Neuronal Death"

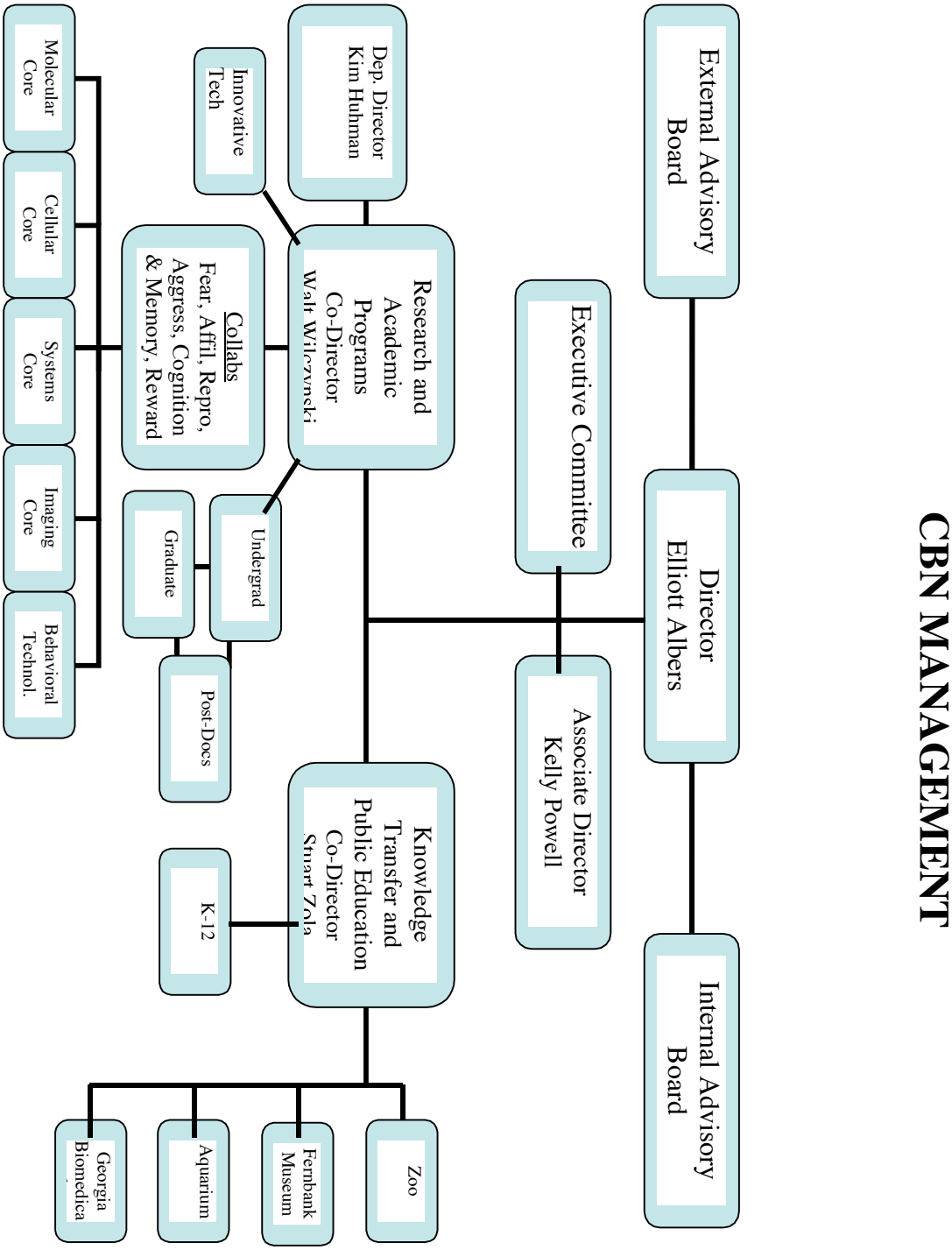
October 9th - CBN Neuroscience in the Movies (featured film: A Beautiful Mind)
Elaine Walker, Ph.D., Professor of Psychology, Emory University
Fernbank Museum of Natural History

X. BUDGET

XI. APPENDICES

Appendix A: Biographical Information of New Faculty Recruits
None

Appendix B: Management Structure



Appendix C: Minutes of Advisory Committee Meetings

Report of the CBN External Advisory Board (EAB): April 2, 2007
Board Members Attending: Anne Etgen, Chair; Thomas Callaway, Gregory Florant, Joe Martinez, Christine Massey, Margaret McCarthy, John McDonald, Donald Pfaff and Leslie Ungerleider

The EAB discussed how to articulate why the member institutions of the CBN should provide institutional support for the CBN to continue after NSF funding ends in 2009. The EAB created a compelling document, signed by all current and many former EAB members, on the innovative new approaches to research, training and public education that have been developed by the CBN over the last seven years and how this inter-institutional community creates unique opportunities for the member institutions now and into the future (below).

April 2, 2007
We, the current and former members of the External Advisory Board of The Center for Behavioral Neuroscience (CBN), affirm the critical importance of CBN in furthering the integration of scientific research and education among a variety of the region's institutions. CBN is unique and internationally acclaimed for its cutting-edge, state of the art research, training in behavioral neuroscience and public outreach. This Center serves as a model for training the next generation of neuroscientists, and benefits from the inclusion of a diverse population of faculty and students. The infrastructure developed by CBN in research, education, and outreach, both within and beyond Atlanta, is a precious and unparalleled resource.
CBN is about research excellence:
• Establishing inter-institutional and interdisciplinary research by developing novel collaboratories that promote translation of basic research for the benefit of human health.
• Creating mechanisms for seeding new research leading to major breakthroughs.
• Consistently leveraging funding to garner additional research support and catalyzing recruitment and retention of faculty for its member institutions.
CBN is about innovation in science education:
• Using the excitement of discovery to make science engaging at all levels of education.
• Integrating enhanced research opportunities into the educational process at the high school, undergraduate and graduate levels.
• Attracting and promoting the success of a diverse population of students and faculty in science.
CBN is about outreach:
• Organizing large scale and local community outreach programs, including thousands of participants in the Zoo Atlanta Expo and summer programs for K-12 science teachers.
• Sponsoring national workshops to define the future of behavioral neuroscience.
• Creating partnerships with the biotechnology industry, the Georgia Research Alliance and other regional organizations.

At this critical juncture, CBN merits and requires strong institutional commitments to capitalize upon the momentum generated during the past seven years. This essential support will enhance the missions of its participating institutions and allow them and CBN to realize their full potentials.

Sincerely,
CBN External Advisory Board members, 2000-2007

Appendix D: Media Publicity Materials

None

Appendix E. Publications and Presentations

Publications (n = 299):

Agid Y, Byzsaki G, Diamond D, Frackowiak R, Giedd J, Girault JA, Grace A, Lambert J, Manji H, Mayberg H, Popoli M, Prochiantz A, Richter-Levin G, Somogyi P, Spedding M, Svenningsson P, Weinberger D. Viewpoint: How can drug discovery for psychiatric disorders be improved? Nature Reviews: Drug Discovery 6(3):189-201, 2007.

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Davidson, A. The Nervous System. Circadian Rhythms and Sleep Disorders Symposium, Fernbank Science Center, Atlanta, GA, January, 2007.

Davis, M. Neural mechanisms of extinction. Center for Molecular and Behavioral Neuroscience, Rutgers University, Newark, NJ, Oct 25, 2006.

Davis, M. Invited speaker. Neural mechanisms of extinction. Pavlovian Society, Philadelphia, PA, Sept. 15, 2006.

Davis, M. Invited speaker. Neural mechanisms of extinction. Learning, Memory and Brain Plasticity Conference, Schwetzingen Castle, Germany, Oct. 6, 2006.

Davis, M. Neural mechanisms of extinction: Implications for psychotherapy. National Institute of Health Neuroscience Series speaker, National Institute of Health, Bethesda, MD, Oct 25, 2006.

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Derby, C. Chemical defenses and communication in sea hares and other inking animals. University of Florida, The Whitney Laboratory, January 19, 2007.

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Deshpande G, LaConte S, Peltier S and Hu X. Directed transfer function analysis of fMRI data to investigate network dynamics. Proc. of 28th Annual International Conference of IEEE EMBS, 2006.

Dodla, Mahesh C., Valerie K. Haftel, Ravi V. Bellamkonda . Anisotropic hydrogel scaffolds enhance peripheral nerve regeneration across long nerve gaps. Society for Biomaterials conference, April 18-21, 2007.

Doherty, J. M., Song, C. K. and Bartness, T. J. Sympathetic and sensory re-innervation of transplanted white adipose tissue (WAT). Society for Neuroscience, San Diego, CA, 2007

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Farran, L.K., McManus, S.M., & Robins, D.L. Screening for autism spectrum disorders: A collaboration between neuropsychologists and primary care providers. International Neuropsychological Society meeting, Portland, OR, February, 2007.

Farran, L.K., Wiggins, L.D., Oliver, K.B., & Robins, D.L. Does performance on the Early Social Communication Scale differentiate between toddler with ASD and toddlers without ASD? International Meeting for Autism Research,

Seattle, WA, May, 2007.

Feldman, A., Adams, S., Hybinette, M. and Balch, T. A Tracker for Multiple Dynamic Targets Using Multiple Sensors. Video Submission. IEEE International Conference on Robotics and Automation, 2007.

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Flemming, T. M., Beran, M. J., & Washburn, D. A. Reasoning of Same/Different Size Analogies by Rhesus Monkeys (Macaca mulatta). Paper presented at the annual meeting of the Southern Society for Philosophy and Psychology, Atlanta, GA, April, 2007.

Ford, B. Duke University, Neurology Seminar Series, 2006.

Ford, B. International Symposium on Neuroprotection and Neurorepair:Cerebral Ischemia and Stroke, Magdeburg, Germany, 2006.

Frantz, K.J. "Two Routes to Research: Bench and Education Science at GSU" Georgia State University Graduate Seminar, Atlanta, July 2007.

Frantz, K.J. "Lessons Learned from BRAIN Research" STC Broadening Participation Workshop on Diversifying the Science & Engineering Workforce. San Francisco, March 2007.

Frantz, K.J., LL. Carruth, and R.L. DeHaan. 2006. Best Practices in Science Education: a conference on active teaching and learning. Society for Neuroscience Meeting, Atlanta, GA, 2006.

Fugate, Jennifer B., and Harold Gouzoules. Categorical perception of expression in chimpanzees (pan troglogytes). The International Society of Research on Emotion meetings at The University of Queensland, July 11-14 2007.

Fugate, Jennifer M.B. & Gouzoules, Harold. Categorical Perception of Expressions in Chimpanzees. 16th International Society for Research on Emotion, Sunshine Coast, Australia, July, 2007.

Fugate, Jennifer M.B. Categorical Perception of Emotional Expressions in Chimpanzees. 8th Keck Center student/Postdoc Symposium, W.M. Keck Center for Behavioral Biology, Raleigh, NC, January, 2007.

Fugate, Jennifer M.B. Categorical Perception of Expressions in Chimpanzees. 14th International Conference on Comparative Cognition, Melbourne, FL, March, 2007.

Fugate, Jennifer M.B. Communicating Emotion: Facial Expressions and Vocalizations in Human and Non-human Primates. Graduate Research Interdisciplinary Talk Series, Graduate School of Emory University, Atlanta, GA, May, 2007.

Fukuhara, C. The role of circadian clocks in the regulation of arylalkylamine N-acetyltransferase gene expression in the mouse pineal gland. University of Louis Pasteur, Strasbourg, France, April 2, 2007.

Galindo, E., Y. K. Zhang, B. Kocher, R. C. Liu. Towards an awake auditory cortex electrophysiology preparation in the mouse. 30th Annual Meeting of the Association for Research in Otolaryngology, Denver, CO, Feb. 10-15, 2007.

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of Traumatic Stress Studies, St. Louis Missouri, 2007.

Glasper, E.R., Neigh, G.N., Zhang, N., DeVries, A.C. Neuronal protection mitigates alterations in peripheral immune function following transient focal ischemia. The Society for Neuroscience Annual Meeting, Atlanta, GA, October 14 -18, 2006.

Glavis-Bloom, C, Alvarado, M.C., Bachevalier, J. Neonatal hippocampal damage impairs specific place/food associations in adult macaques. Society for Neuroscience, Atlanta, GA, 2006.

Glavis-Bloom, C. Hippocampal damage impairs specific place/food associations in adult macaques. Annual Symposium, Keck Center for Behavioral Biology, NCSU, Raleigh, NC, 2007.

Glover, E.M., & Davis, M. Differing effects of electroconvulsive shock on consolidation of trace versus delay fear conditioning. International Behavioral Neuroscience Society, Rio de Janeiro, Brazil, June, 2007.

Glover, E.M., Davis, M. Tolerance and cross- tolerance to the anxiolytic and analgesic effects of morphine & buprenorphine administration in the rat. American Psychological Association 114th Annual Convention, New Orleans, LA, August, 2006.

Glover, E.M., Davis, M. Tolerance, Cross- tolerance, & Withdrawal Effects of Morphine & Buprenorphine in Anxiety & Analgesia. Society for Neuroscience 36th Annual Meeting, Atlanta, GA, October, 2006.

Grand, A, Maestripieri, D, McCormack, KM, Higley, D, Lindell, SG, Alagbe, O, Felger, J, Miller, A, and Sanchez, MM. Early adverse caregiving impacts monoaminergic systems in rhesus monkeys: relation to behavioral reactivity and inflammatory signaling. Society for Neuroscience Annual Meeting, October, 2006.

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Gutman, A.R., J.Chhatwal, M. Davis. Neuropeptide Y modulation of startle. Society for Neuroscience Meeting, Atlanta, GA, 2006.

Gutzler, S., Karom, M., Albers, H.E. Differential regulation of Vasopressin receptor binding in limbic structures in female Syrian hamsters. Society for Behavioral Neuoendocrinology, Monterey, CA, 2007.

Halmon, W., & Stansbury, K. The Effects of Dam LG-ABN on Rat Pup Ultrasonic Vocalizations and HPA Stress Responses. AUC Psychology Research Day, Clark Atlanta University, Atlanta, Georgia, April 2007.

Hamann, S. B., & Vytal, K. E. Acquisition and Extinction of contextual Fear. Cognitive Neuroscience Society annual meeting, New York, NY, May, 2007.

Hampton, R.R. Invited speaker. Buena Vista University, Storm Lake, IA, April, 2007.

Hampton, R.R., Manzanares, C., Zola, S. Direct assessment of perceptual competence in monkeys with damage to perirhinal cortex by manipulation of "feature ambiguity." 36th Annual Meeting of the Society for Neuroscience, Atlanta, GA, October, 2006.

Hanberry, R., Murphy, A., & Petrulis, A. NK1 Receptor Distribution in the Limbic System of the Golden Hamster (Mesocricetus auratus). Society for Neuroscience, San Diego, CA, 2007.

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Hasenkamp W, Kelley M, Egan G, Green A, Lewison B, Boshoven B, Keyes J, Duncan E. Prepulse inhibition of startle is reduced in family members of schizophrenia patients. International Congress on Schizophrenia Research, Colorado Springs, CO, 2007.

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Hassett, J. M., Martin-Malivel, J., Stephens, S. B. Z., Lange, H., Fischer, A. and Wallen, K. Voluntary Cognitive Performance in Rhesus Monkeys: Sex, Age, and Social Rank. 11th Annual Meeting of the Society for Behavioral Neuroendocrinology, Pacific Grove, CA, June 21-24, 2007.

Hassett, J., Briggs, P., DiDonato, M., Berenbaum, S., Martin, C., and Wallen, K. Sex Differences in Object Preferences in Children and Rhesus Monkeys. Presented at the Society for Behavioral Neuroendocrinology meeting in Pittsburgh, PA, June 17-20, 2006.

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Hecht, E.E., Marcaro, J., Gutman, D., Hamann, S., Preuss, T.M., and Rilling, J. Comparing amygdala connectivity between monkeys, apes, and humans using diffusion tensor imaging. Society for Neuroscience Annual Meeting, San Diego, CA, November 4-8, 2007

Heim, C. Acute and Long-term Influences of Psychological Factors on HPA Axis Activity: Implications for Psychiatric Disorders (Lecture). Depression Center Colloquium Series, University of Michigan Depression Center, Ann Arbor, MI, 2007.

Heim, C. Frühe Stresserfahrungen, Depression und funktionelle somatische Störungen und Schmerzsyndrome. Symposium on Affective Disorders across the Life Span (CME Plenary Lecture). University Hospital Freiburg, Germany, 2007.

Heim, C. Neuroendocrinology of Depression: Role of Childhood Trauma. Clinical Outcomes Conferences, Emory Program in Cardiovascular Outcomes Research and Epidemiology (EPICORE), Emory University School of Medicine, Division of Cardiology, 2007.

Heim, C. Neuroendocrinology of Depression. Plenary Keynote CME-Speaker at Berliner Psychiatrie-Tage. Charite University Hospital, Berlin, 2007.

Heim, C. The Link between Childhood Trauma and Depression: Insights from HPA Axis Studies in Humans. 2007 Curt Richter Award Presentation. International Society for Psychoneuroendocrinology. Madison, WI, 2007.

Heintz, M. & Parr, L.A. Chimpanzees are not stressed during difficult cognitive tasks. The Chimpanzee Mind, Lincoln Park Zoo, Chicago IL, March 23-26, 2007.

Heldt, Scott, A., and Kerry J. Ressler. Training-induced changes in the expression of GABA(A) receptor subunits and

GABAergic associated genes in the amygdala after the acquisition, retrieval, and extinction of Pavlovian fear. Society for Neuroscience meeting, Atlanta, GA, 2006.

Heuer, E.D., E.L. Mariola, R.F. Stilla, S. J. Peltier, S. LaConte & K. Sathian. Tactile spatial learning recruits activity in a widespread neural network. Society for Neuroscience Meeting, Atlanta, GA, 2006.

Hoffman, J.B. "A Nonhuman Primate Model for the Assessment of Stress-Induced Obesity." Institutional Research and Academic Career Development Award Conference, San Diego, CA, 2007.

Hoffman, J.B. "Analysis of Immunoreactive Inhibin 945-Subunit Throughout the Estrous Cycle of Asian and African Elephants." Society for the Study of Reproduction Conference, San Antonio, TX, 2007.

Hoffman, J.B. "Fellowships in Research and Science Teaching (FIRST) Provides Postdoctoral Fellows a Unique Opportunity to Enhance Both Research and Teaching Skills." Society for the Study of Reproduction Conference, San Antonio, TX, 2007.

Hoffman, J.B. "Hormonal Regulation of the Activin Type IA and IB Receptors During Follicular Development in Broiler Breeder Hens." International Poultry Scientific Forum, Atlanta, GA, 2007.

Hoffman, M., Beran, M. J., & Washburn, D. A. Working Memory for What-Where-When Information in Rhesus Monkeys (Macaca mulatta). Paper presented at the annual meeting of the Southern Society for Philosophy and Psychology, Atlanta, GA, April, 2007.

Hopson, J., Y. Kim, V. K. Haftel . Nanoparticle delivery of insulin may be used to treat proprioceptor deficits found in diabetic rats. Society for Neuroscience meeting, Atlanta, GA, 2006.

Hopson, J., Y. Kim, V. K. Haftel. Nanoparticle delivery of insulin may be used to treat proprioceptor deficits found in diabetic rats. Annual Biomedical Research Conference for Minority Students (ABRCMS), Anaheim, California, Nov. 8 -11, 2006.

Hu, X. "Alternative Approaches for MR Molecular Imaging with Magnetic Nanoparticles," Department of Radiology, Northwestern University, Chicago, IL, June 2007.

Hu, X. "An Overview of fMRI: Techniques and Applications," Siemens Mindit Magnetic Resonance Ltd., Shenzhen, China, October 2006.

Hu, X. "Dynamic Studies of Brain Function and Connectivity," Neuroscience Seminar, University of South California, Los Angeles, CA, September 2006.

Hu, X. "Dynamic Studies of Brain with fMRI," First Conference of Sino-Western Exchanges in Cognitive Neuroscience, Beijing, China, October 2006.

Hu, X. "fMRI: from Basics to the State of Art," European Society for Magnetic Resonance in Medicine and Biology Workshop on MR Physics for Physicists, Huangshan, China, October 2006.

Hu, X. "Magnetic Nanoparticles for Molecular Imaging: Physics, Chemistry and Biology," Department of Radiology Grand Round, University of Washington, Seattle, WA, April 2007.

Hu, X. "Non-Cartesian Trajectories and Parallel Imaging," ISMRM Workshop on High Field MR, Pacific Grove, CA, March 2007.

Hu, X. "Probing Brain Function and Functional Connectivity with MRI," Tsinghua University, Beijing, China, October 2006.

Inman, C., Mumaw, M., & King, T. Emotional awareness and psychophysiological markers of performance on the Iowa Gambling Task. American Psychological Society, Washington DC, May, 2007.

James, F., Washburn, D., & Beran, M. J. A Cross-Cultural Comparison of Attention Factors, Skills, and Biases. Poster presented at the annual meeting of the Association for Psychological Science, Washington, DC, May, 2007.

Jarkas N, Voll RJ, Williams LA, Votaw JR, Goodman MM, Synthesis and Evaluation of a Serotonin Transporter (SERT) PET Imaging Agent: 11C-BrHOMADAM, J Labelled Comp and Radiopharm, 50(S1) S295, 2007.

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Jean, D.K., Flowers, A.C., Clark, P., & Stansbury, K. Young Women's Mental Health Outcomes Following Early Sexual Trauma. Poster presented at AUC Psychology Research Day, Clark Atlanta University, Atlanta, Georgia, April 2007.

Jones H, Ressler KJ, Acker C, Stephens K, Gillespie CF, and Schwartz A. Abnormal lipid metabolism in patients attending a general medical clinic with undiagnosed or untreated Post-traumatic Stress Disorder. International Society of Traumatic Stress Studies, St. Louis, Missouri, 2007.

Jovanovic, T., Norrholm, S.D., Jambrosic-Sakoman, A., Esterajher, S., Kozaric-Kovacic, D., Davis, M., & Duncan, E. Conditioned and external fear inhibition in combat- related PTSD in Croatian war veterans. 37th Annual Meeting of the Society for Neuroscience, San Diego, CA, 2007.

Jutras, M.J., Fries, P., and Buffalo, E.A. Hippocampal Gamma-Band Synchronization During Encoding Predicts Successful Recognition Memory. Society for Neuroscience, Atlanta, GA, 2006.

Kamio M, Reidenbach MA, Derby CD. The courtship display of male blue crabs (Callinectes sapidus) is a chemical signal to females. At Benthic Ecology Meetings, Atlanta, GA, March 21 - 24, 2007.

Kamio, M. "Candidate sex pheromone molecules in Blue crab, Callinectes sapidus." Graduate School of Fisheries Science, Hokkaido University, Hakodate, Hokkaido, Japan, October 15, 2006.

Kamio, M. "Communication between male and female: Sex pheromone of helmet crab, Telmessus cheiragonus." Satellite Symposium of Annual meeting of the Carcinological Society Japan, Hakodate, Hokkaido, Japan, October 13 -15, 2006.

Keen-Rhinehart, E., McCormack, K., Hoffman, J.B., Sabatier, M., Eisen, A., Haynes, J.K., and Eaton, D. Interactive methods for teaching action potentials by postdoctoral fellows in the Fellowships in Research and Science Teaching (FIRST) program. Society for Neuroscience meeting, San Diego, CA, 2007.

Keen-Rhinehart, E., Neigh, G.N., Joseph, I.M., Eisen, A., Haynes, J.K., Eaton, D.C. FIRST: A model for generating new faculty members adept at both teaching and research. The Society for Neuroscience Annual Meeting, Atlanta, GA, October 14-18, 2006.

Keen-Rhinhert, E., V. Michopoulos, L. Martin, D. Toufexis, K. Ressler, M. Wilson. Increased CRH in central amygdala inhibits sexual motivation. Society for Behavioral Neuroendocrinology meeting, Monterey, CA, 2007.

Keilholz, S. Social network analysis of functional connectivity. 15th Annual ISMRM, Berlin, 2007.

Kelley ME, Craddock C, Holtzheimer P, Kennedy SH, Mayberg HS. Resting State Brain Connectivity as Predictors of Treatment Response in Major Depression. Biol Psych Annual Meeting, San Diego, 2007.

Kerr, J., Barrett, N., & Washburn, D. Stop! Do I Shoot? Individual Differences in Shoot/Don't-Shoot Performance.

Poster presented at the Georgia State University Psychology Undergraduate Research Conference, Atlanta, GA, March, 2007.

Kim, Y., V.K. Haftel, H. Lee, R.V. Bellamkonda . Delivery of biodegradable calpeptin-nanoparticles significantly protect neurons from injury related death after spinal cord injury. Society for Neuroscience meeting, Atlanta, GA, 2006.

King, T., Morris, R., Yu-Sheng, H., Chai, D., Krawiecki, N. Longitudinal models of adaptive behaviors in children treated for brain tumors. International Neuropsychological Society, Portland, OR, February, 2007.

King, T., Papazoglou, A. Morris, R.D., & Krawiecki, N. Attention problems in survivors of pediatric brain tumors predict adult adaptive outcomes. American Academy of Clinical Neuropsych, Denver, CO, June, 2007.

Koshkin V, Bermudez P, Seelig D, Danzy JL, Whitten PL, Gerald MS. The relationship of fecal glucocorticoid levels with self-grooming rates and frequencies of being displaced in female rhesus macaques (Macaca mulatta) American Journal of Physical Anthropology 132 S44): 147, 2007.

Koylu, E.O., Erdogan, M., Karadeniz, M., Saygili, F., Balkan, B., Pogun, S., and Kuhar, M.J. Plasma CART Peptide Levels in Thyroid Patients: Body Mass Index, Gender, and Age-Related Changes. Society for Neuroscience, Atlanta, GA, 2006.

Kubanek J, Prince EK, Myers T, Naar J. Allelopathic interactions modulate brevetoxin production by the red tide dinoflagellate Karenia brevis. Oral presentation, International Conference on Harmful Algae, Copenhagen, Denmark, 2006.

Kubanek J, Snell TW, Pirkle C. Effects of harmful algae on rotifer feeding behavior and reproduction: red tide dinoflagellate Karenia brevis uses chemical defense to deter grazers. Oral presentation, Benthic Ecology Meeting, Atlanta GA, 2007.

Kubanek J. Chemical cues in the ocean: focus on undergraduate research. ACS Herty Medal Symposium Honoring Luis Echegoyen, Morehouse College, Atlanta GA, 2007.

Kubanek J. Chemically-mediated interactions among marine competitors, hosts, and parasites. US-Japan Symposium on Marine Bioorganic Chemistry, Salt Lake City, Utah, 2007.

Kubanek J. Natural products as chemical cues in marine environments. Gordon Research Conference on Natural Products Chemistry, Tilton, NH, 2007.

Kuhar, M.J. Introduction of the Nathan B. Eddy Recipient. Proceedings of the 68th Annual Scientific Meeting, The College on Problems of Drug Dependence, 2007.

Lake, J. I. Lange, H. S., Mayer, L. D., O'Brien, S. and Maney D. L.. Neuroendocrine correlates of behavioral polymorphism: Gonadotropin-releasing hormone, GA/SC Neuroscience Consortium, Augusta, GA, 2007.

Lane AL, Prusak AC, Hay ME, Snell TW, Giese RA, Hardcastle KI, Fairchild CR, Aalbersberg W, Raventos-Suarez C, Kubanek J. Novel antineoplastic diterpene-benzoates from the Fijian red alga Callophycus serratus. Poster presentation. Gordon Research Conference on Marine Natural Products, Ventura CA and American Chemical Society National Meeting, Atlanta GA, 2006.

LaPrairie J.L. The long-term effects of neonatal inflammatory injury. Keck Center for Behavioral Biology Symposium, Raleigh, NC, 2007.

Leung, C.H., Goode, C.T., and Maney, D.L. Morph and sex differences in vasotocin receptor density in White-throated Sparrows. Society for Neuroscience meeting, Atlanta, Georgia, 2006.

Levey, A.I. Alzheimer's Disease Clinical Studies Initiative Pilot Program. The National Alzheimer's Association,

Atlanta, GA, May 15, 2007.

Levey, A.I. Alzheimer's Disease Master's National Symposium, Seattle, WA, October 28, 2006.

Levey, A.I. Iris Murdoch and Alzheimer's Disease. Fernbank Museum and Center for Behavioral Neuroscience, Atlanta, GA, April 3, 2007.

Levey, A.I. Muscarinic Receptor Regulation Of Amyloid Precursor Protein Processing In Primary Neuronal Culture. Eighth International Conference on Alzheimer's Disease/Parkinson's Disease, Salzburg, Austria, March 16, 2007.

Levey, A.I. Sorting Out Alzheimer's Disease Pathogenesis. Burke Rehabilitation Institute, Cornell University, White Plains, New York, November 14, 2006.

Levey, A.I. Speaking of Science: "Alzheimer's Disease: Will We Find A Cure?" Moderated by William Safire and Co-sponsored by the College of Arts and Sciences at Syracuse University and the Dana Foundation. Washington, D.C. , June 12, 2007.

Levey, A.I. Staying Sharp: Current Advances in Brain Research. Dana Alliance for Brain Initiatives and the American Association of Retired Persons (AARP) Division of National Retired Teacher's Association. Marietta, Georgia, November 18, 2006.

Levey, A.I. Treatment Approaches for Alzheimer's Disease with Acetylcholine and ApoE Receptors. Amgen, Thousand Oaks, CA, March 27, 2007.

Lin S.M., Krebs-Kraft DL, and Huhman, K.L. Temporary inactivation of the anterior dorsal hippocampus does not alter the behavioral effects of social defeat in male Syrian hamsters. Society for Neuroscience, Atlanta, GA, 2006.

Lin, C., Li, J., Barrett, N., Zhang, Y-Q., & Washburn, D. A. A Cognitive Genetic Algorithm for Recognition of Visual Prototypes and Distortions. Poster presented at the annual meeting of the Society for Computers in Psychology, Houston, TX, November, 2006

Lin, F., E. Galindo-Leon, B. Kocher, S. Freeman, R. C. Liu. Exploring task dependent plasticity in the auditory cortex. GA Tech-Emory IGERT Orientation, Atlanta, GA, August 17, 2007.

Liu, R.C. A mouse model for the cortical processing and learning of natural communication sounds. Association for Research in Otolaryngology Symposium on Neural Correlates of Social Communication Signals, Denver, CO, Feb. 10 -15, 2007.

Liu, R.C. An information theoretic approach to detecting and discriminating mouse communication sounds. GA Tech-Emory IGERT Orientation, Atlanta, GA, August 18, 2006.

Liu, R.C. Auditory cortical detection and discrimination correlates with communicative significance in a mouse model. 36th Annual Meeting of the Society for Neuroscience, Atlanta, GA, October 17, 2006.

Liu, R.C. Communication coding in mouse cortex: from sounds to spikes, Georgia State University Biology Graduate Seminar. Atlanta, GA, March 23, 2007.

Liu, R.C. Sensory plasticity in the maternal state: from cries to cortex. Parental Brain Conference, Boston, MA, June 7-10, 2007.

Lorenzi, Varenka , Ryan L. Earley, and Matthew S. Grober. Group composition and group stability in the sex changing bluebanded goby (Lythrypnus dalli). Benthic Ecology Meeting, Atlanta, GA, March 2007.

Lorenzi, Varenka. "Sex change in marine fishes." Wrigley Institute of Environmental Studies Summer Seminar series, Catalina Island, CA, August 2006.

Lorenzi, Varenka. Russ E. Carpenter, Cliff H. Summers, Matthew S. Grober. Serotonin, social status and sex change in the bluebanded goby Lythrypnus dalli. Society for Behavioral Neuroendocrinology Annual Meeting, Asilomar, CA, June 2007.

Loyd, D.R. Sex Differences in Morphine Analgesia. 14th Annual Animal Behavior Conference at the Center for the Integrative Studies of Animal Behavior, University of Indiana, Bloomington, Indiana, 2007.

Lu, Hang, Cori Bargmann, Sam Fielden, Katie Mevs. "Microfluidic devices for studying olfaction behavior in C. elegans", BMES, Chicago, October 2006.

Lu, Hang, Sam Fielden, Katie Johnson Mevs. "Microfluidic devices for studying olfaction behavior in C. elegans", AIChE, San Francisco, November 2006.

Lu, Hang, Samuel Fielden, Kathryn Johnson Mevs. "BioMEMS devices for studying C. elegans olfaction behavior", Annual Meeting, AIChE, San Francisco, CA, November 2006.

Lu, Hang. "Microfluidics – high-throughput experimental tools for neuroscience and cell biology", Integrated BioSystems Initiative symposium day, Georgia Tech, March 14, 2007.

Lu, Hang. "Probing worm mind and prodding cell behavior with microfluidics", NIST Polymer Division seminar, March 12, 2007.

Lu, Hang. "Probing worms' brain and behavior with microfluidics", Chemical Engineering Department seminar, Princeton University, Oct 24, 2007.

Lu, Hang. DARPA MTO PI meeting, Long Beach, CA, July 25-26, 2007.

Lu, Hang. GA/SC Neuroscience Consortium meeting, Augusta, GA, April 21 2007.

Lutterschmidt, D.I. and W. Wilczynski. Distribution of kisspeptin in the brain of green treefrogs (Hyla cinerea). Eleventh Annual Meeting of the Society for Behavioral Neuroendocrinology. Pacific Grove, California, 2007.

Lutterschmidt, D.I., L.A. Dunham, and W. Wilczynski. Comparative anatomy of kisspeptin-like immunoreactive neuron distribution in two ectothermic model systems. Annual Meeting of the Society for Neuroscience. San Diego, California, 2007.

Maguschak K.A. and Ressler K.J. Beta-Catenin is required for the consolidation of fear memories in adult mice. IBRO World Congress of Neuroscience, Melbourne, Australia, 2007.

Main, K. L. , Moloney, K. P., Kinzel, E. N., Ginn, J., Primo, S., Jacko, J., Schumacher, E. H. Functional neuroimaging evidence that visual input to the preferred retinal location in patients with macular degeneration elicits cortical reorganization. Presented at Cognitive Neuroscience Society Annual Meeting, New York, May, 2007.

Main, K. L. Cortical reorganization in response to preferred retinal locations. Georgia Tech Graduate Student Technical Symposium, Atlanta, GA, March, 2007.

Main, K. L. The Reorganization of Adult Cortical Topography. Georgia Tech Graduate Student Research Symposium, Atlanta, GA, March, 2007.

Main, K. L., Moloney, K. P., Kinzel, E. N., Ginn, J., Primo, S., Jacko, J., Schumacher, E. H. Neuroimaging evidence that PRL use elicits reorganization of cortical topography in V1. GA/SC Neuroscience Consortium, Medical College of Georgia, Augusta, GA, April, 2007.

Main, K.L. & Schumacher, E. H. Evidence of cortical reorganization observed in a patient with age-related macular degeneration. Presented at Sigma Xi Annual Meeting and Student Research Conference, Detroit, MI, November, 2006.

Majeed W, Jones S, Ressler KJ, and Keilholz S. Visualization of Laminar and Columnar Organization in Rat Olfactory Bulb using Diffusion Tensor MRI. ISMRM-ESMRMB Joint Annual Meeting, Berlin, Germany, 2007.

Majeed, W, M Magnuson, S Keilholz. Manganese enhanced MRI of olfactory pathway in developing rats. 15th Annual ISMRM, Berlin, 2007.

Maney, D.L. Invited speaker. Department of Psychology, University of Texas, Austin, TX, 2007.

Mao H., D. J. Toufexis, Wang X, Wu S. Lacreuse A. Metabolic Responses in Kanic Acid Induced Lesion in Rat. International Society for Magnetic Resonance in Medicine, Seattle, WA, 2006.

Maras, P. & Petrulis, A. Inhibitory neurons within the medial amygdala respond to same sex odors in male Syrian hamsters. Society for Neuroscience, San Diego, CA, 2007.

Maras, P. and Petrulis, A. The role of the posteromedial cortical nucleus of the amygdala in generating opposite-sex odor preference and copulatory behavior in male Syrian hamsters. Poster presentation, Society for Neuroscience, Atlanta, GA, 2006.

Maras, P. and Petrulis, A. The role of the posteromedial cortical nucleus of the amygdala in generating opposite-sex odor preference and copulatory behavior in male Syrian hamsters. Society for Behavioral Neuroendocrinology, Asilomar, CA, 2007.

Markham, C., and Huhman, K. The Role of the Medial Amygdala on the Acquisition and Expression of Conditioned Defeat in Syrian Hamsters. Society for Neuroscience meeting, Atlanta, GA, October, 2006.

Mascaro JS, Miura A, Rilling JK, Glasser MF, Preuss TM, Behrens TEJ. A comparison of cerebellar connectivity in humans, chimpanzees, and rhesus macaques using diffusion tensor imaging (DTI) and probabilistic tractography. Soc Neuroscience Meeting, Atlanta, GA, 2006.

Mayberg HS. Dal Grauer Lecturer, University of British Columbia, Vancouver, Canada, 2006.

Mayberg HS. David Seegal AOA Visiting Professorship Lecture, Columbia University, New York, 2007.

Mayberg HS. Edwin Gildea Lecturer, Washington U, Dept Psychiatry, St. Louis, MO, 2007.

Mayberg HS. Keynote Speaker, International Neuropsychiatry Meeting, Sydney, Australia, 2006.

Mayberg HS. Plenary Lecturer, British Neuroscience Association, North Yorkshire, UK, 2007.

Mayberg HS. Presidential Lecture Speaker, Society for Biological Psychiatry Annual Meeting, Toronto, 2006

Mayberg HS. Psychiatry Grand Rounds, Johns Hopkins, Baltimore, MD, 2007.

Mayberg HS. Ved Sachdev MD Endowed Lecture, Mount Sinai, Dept Neurosurgery, NY, 2006.

Mayberg HS. Visiting Neuroscience Lecturer, Dept of Neuroscience, Stanford U, CA, 2007.

McClure, E.B. & Pine, D.S. Research on Pediatric Anxiety: A Systems Neuroscience Approach. In symposium entitled: Integrating Biological and Environmental Perspectives on Internalizing Problems in Young Children (L. Leve (Chair). Society for Research in Child Development Biennial Meeting, Boston, MA, March, 2007.

McClure, E.B., Parrish, J., Nelson, E. E., Schroth, E., Fani, N., Monk, C.S., Ernst, M., & Pine, D.S. Neural, behavioral and emotional responses to social conflict in youth with mood and anxiety disorders. In symposium entitled: Affective neuroscience approaches to developmental psychopathology (C.S. Monk (Chair). Society for Research in Child Development Biennial Meeting, Boston, MA, March, 2007.

McCormack,K.M., Warfield,J.J., Dozier,M., Gunnar,M.R., Maestripieri,D., Waters,E., Sanchez,M.M. Maternal Maltreatment is Associated with Lower Attachment Security in Infant Rhesus Monkeys (Macaca mulatta). 30th Annual Meeting of the American Society of Primatologists, Winston-Salem, NC, June 2007.

McGraw, Lisa. "Sexual selection and the mechanisms underlying female x male interactions." Ecology and Evolution Seminar Series, Emory University Population Biology, Atlanta, GA, April 2007.

McLoon LK, Chistiansen SC and Mustari MJ. Effect of sustained release IGF-I on the medial rectus of infant non-human primates. ARVO meeting, 2007.

McManus, S.M., Banks, M.S., King, T.Z., & Robins, D.L. Emotion perception in adolescents with autism spectrum disorders. Georgia Psychological Association meeting, Atlanta, GA, May, 2007.

Metwalli NS, LaConte SM, and Hu X. An information theoretic approach characterizing diffusion anisotropy in diffusion-weighted magnetic resonance images. Proc. of 28th Annual International Conference of IEEE EMBS, 2006.

Michopoulos, V., E. Keen-Rhinehart, L. Martin, D. Toufexis, K. Ressler, M. Wilson. Increased CRH in central amygdala inhibits sexual motivation. Society for Behavioral Neuroendocrinology meeting, Monterey, CA, 2007.

Micklewright, J., King, T., Papazoglou, A., Mumaw, M., Morris, R. Quantifying the interactive effects of tumor and treatment risk factors in children with brain tumors: The development of the Neurological Risk Scale. National Academy of Neuropsychology, San Antonio, TX, October, 2006.

Micklewright, J.L., Kapahi, S., King, T., Morris, R.D., Krawiecki, N. Family functioning at diagnosis as a predictor of later adaptive functioning in pediatric brain tumor survivors. American Academy of Clinical Neuropsychology, Denver, CO, June, 2007.

Miles, D.L. Walker, M. Davis. Further refinement of a behavioral paradigm to analyze short- versus long-duration fear responses. APA Diversity Program in Neuroscience Poster Preview, Society for Neuroscience Conference, Atlanta, GA, October, 2006.

Miles, L.A., D.L. Walker, M. Davis. Final refinement of a behavioral paradigm to analyze short- versus long-duration fear responses. New England Science Symposium, Harvard University. Boston, MA, March, 2007.

Miller, A.H. “Are There Obvious Targets for Controlling Inflammation-Associated Symptoms?” Cytokines and Depression III, Bordeaux, France, 2007.

Miller, A.H. “Cytokines Sing the Blues: Inflammation and the Pathogenesis of Depression” Grand Rounds, University of North Carolina, Chapel Hill, NC, 2007.

Miller, A.H. “Cytokines Sing the Blues: Inflammation and the Pathogenesis of Depression”, Annual Grass Foundation Lecture, Louisiana State University School of Medicine, Shreveport, LA, 2007.

Miller, A.H. “Cytokines Sing the Blues: Inflammation and the Pathogenesis of Depression”, Annual Meeting of the American Association of Immunologists, Miami, FL, 2007.

Miller, A.H. “Cytokines Sing the Blues: Inflammation and the Pathogenesis of Depression”, Frontiers of Science Program, New York Academy of Sciences, NY, NY, 2006.

Miller, A.H. “Cytokines Sing the Blues: Inflammation, Stress and the Pathogenesis of Major Depression” in Depression, Inflammatory Markers, and Medical Illness: Is this a Two-Way Street?” Symposium of the annual meeting of the Collegium Internationale Neuro-Psychopharmacologicum, Chicago, IL, 2006.

Miller, A.H. “Inflammation and the Brain: A Pathophysiologic Process at the Interface of Medicine and Psychiatry,” Rheumatology Grand Rounds, Emory University School of Medicine, Atlanta, GA, 2006.

Miller, A.H. “Inflammation and the Brain: A Pathophysiologic Process at the Interface of Medicine and Psychiatry”, Future Leaders Meeting, sponsored by Emory University School of Medicine, Miami Beach, FL, 2006.

Miller, A.H. “Inflammation and the Brain: Relevance to Depression and other Behavioral Co-Morbidities in Patients with Cancer”, Grand Rounds, Division of Medicine, MD Anderson Cancer Center, Houston, TX, 2006.

Miller, A.H. “Inflammation and the Brain: Relevance to Health and Behavior”, Invited lecture, American College of Psychiatrists annual meeting, San Juan, Puerto Rico, 2006.

Miller, A.H. “Neuropsychiatric Adverse Effects of Interferon-alpha: Do They Tell Us Anything About Depression” Depression: Brain Causes – Body Consequences symposium, Royal Society of Medicine, Institute of Psychiatry, King’s College London, UK, 2007

Miller, A.H. “Stress, Inflammatory Signaling and Glucocorticoid Receptor Function: Role in Affective Disorders”, In: Stress and Glucocorticoid Receptors in Affective Disorders: From Bench to Bedside, Symposium of the annual meeting of the Collegium Internationale Neuro-Psychopharmacologicum, Chicago, IL, 2006.

Moffett, M. and Kuhar, M.J. Preliminary Evidence of Transient Effects of Maternal Separation on Cocaine Self-administration in Dams. Society for Neuroscience, Atlanta, GA, 2006.

Moore, T.O. Brain-Based Learning to Enhance Student Performance. The Millennial Student: A National Symposium, Faculty Resource Network, San Juan, Puerto Rico, November 17-18, 2006.

Muindi F. & Paul, K.N. Application of Aschoff’s rule in Cryptochrome single and double mutant mice under constant light conditions. Harvard Medical School Undergraduate Research Symposium, Cambridge, MA, 2007.

Mumaw, M., King, T., & Robins, D. Disrupted facial mimicry in autism: Preliminary physiological data during dynamic emotion perception. Poster presented at the annual International Meeting for Autism Research, Seattle, WA, May, 2007.

Mumaw, M., King, T., Legg, A., Morris, R., & Krawiecki, N. Intact serial position effect in children with brain tumors. International Neuropsychological Society, Portland, OR, February, 2007.

Murphy, AZ. Chair, Pediatric Pain Symposium, American Pain Society, Washington, DC, 2007.

Murphy, AZ. Invited lecture. Michigan State University, Lansing, MI, 2007.

Murphy, AZ. Invited lecture. University of Massachusetts Program in Neuroscience, Amherst, MA, 2007.

Myers KM, Funderburk CD, Davis M, Ressler KJ. Differential NMDA receptor involvement in fear extinction occurring 10 min after acquisition (putative erasure of fear) or 72 hrs after acquisition (inhibition of fear). Annual meeting of the Pavlovian Society, Philadelphia, PA, 2006.

Myers KM, Norrholm SD, Vervliet B, Jovanovic T, Boshoven W, Rothbaum BO, Ressler KJ, Duncan EJ, Davis M. Recovery of conditioned fear after extinction is abolished when extinction training occurs within minutes of acquisition. Poster presented at the 27th annual meeting of the Anxiety Disorders Association of America, St. Louis, MO, 2007.

Myers TL, Prince EK, Kubanek J. Gulf of Mexico phytoplankton inhibit brevetoxins produced by the red tide dinoflagellate Karenia brevis. Poster presentation by TL Myers, American Society of Limnology & Oceanography, Santa Fe NM, 2007.

Myers, K.M., M. Davis, and K.J. Ressler. Differential NMDA receptor involvement in fear extinction occurring 10 min after acquisition (putative erasure of fear) or 72 hrs after acquisition (inhibition of fear). Society for Neuroscience meeting, Atlanta, GA, 2006.

Myers, K.M.;S.D. Norrholm; B. Vervliet; T. Jovanovic; W. Boshoven; B.O. Rothbaum; K.J. Ressler; E.J. Duncan; M. Davis. Recovery of conditioned fear after extinction is abolished when extinction training occurs within minutes of acquisition; Anxiety Disorders Association of America, St. Louis, MO, 2007.

Neigh, G.N., Binder, E.B., Plotsky, P.M., Owens, M.J., Taylor, W.R., Nemeroff, C.B. Stress results in region specific decreases in expression of angiogenic factors in the brain. The American College of Neuropsychopharmacology Annual Meeting, Hollywood, FL, December 3-7, 2006.

Neigh, G.N., Glasper, E.R., Bowers, S.L., Zhang, N., Popovich, P.G., DeVries, A.C. Stress increases anxiety-like behavior and microglial activation following cardiac arrest/cardiopulmonary resuscitation. The Society for Neuroscience Annual Meeting, Atlanta, GA, October 14-18, 2006.

Neigh, G.N., Haynes, J.K., Hendrickson, T.W. Formal course work positively impacts the research experience of undergraduates at a historically black college. The Society for Neuroscience Annual Meeting, Atlanta, GA, October 14-18, 2006.

Normandin, J.J., A.Z. Murphy. Feeling Good in the Neighborhood: Trans-Synaptic Tracing of Genitosensory Afferents. Society for Behavioral Neuroendocrinology, Pacific Grove, CA, 2007.

Normandin, J.J., A.Z. Murphy. Sex-differences in nPGi inputs: role in sexual behavior. Morehouse School of Medicine Women,s Health Symposium, Atlanta, GA, 2006.

Norrholm SD, Vervliet B, Jovanovic T, Myers KM, Davis M, Rothbaum BO, Duncan E. Spontaneous recovery of extinguished fear-potentiated startle is observed only when extinction is temporally remote from fear acquisition. Poster presented at the 1st annual meeting of the GA/SC Neuroscience Consortium, Charleston, SC, 2006.

Norrholm, S.D. Impaired fear inhibition in combat and civilian PTSD patients. Gordon Research Conference, Amygdala in Health and Disease: Contributions to Emotional Memories. Bates College, Lewiston, ME, August, 2007.

Norrholm, S.D., Vervliet, B., Jovanovic, T., Myers, K., Davis, M., Rothbaum, B., & Duncan, E. Spontaneous recovery of extinguished fear-potentiated startle in humans is observed only when extinction is temporally remote from acquisition. Undergraduate Research Colloquium, Center for Behavioral Neuroscience, Zoo Atlanta, Atlanta, GA, April, 2007.

Nuding U, Ono S, Mustari MJ, Glasauer S and Buettner U. Smooth-pursuit gain-control: network simulations and experimental analysis. Society for Neuroscience meeting, Atlanta, GA, 2006.

Nye JA, Schuster DM, Yu W, Camp VM, Jeffrey OJ, Goodman MM, Votaw JR, Whole Body PET Dosimetry of the Synthetic Leucine Analogue 1-amino-30[18F]fluorocyclobutane-1-carboxlic acid (anti[18F]FACBC) in Humans, J Nuc Med, 48(S2)132P, 2007.

Okere CO, Waterhouse BD. Activity-dependent heterogeneous populations of nitric oxide synthase-containing neurons in the rat dorsal raphe nucleus. Annual National Symposium on Prostrate Cancer, Atlanta, GA, March 19 -20, 2007.

Okere CO. NO neuroendocrine function. Annual National Symposium on Prostrate Cancer, Atlanta, GA, March 19-20, 2007.

Olazabal, D., and LJ Young. Absence of sexual differences in the quality of spontaneous parental care and oxytocin receptor density in prairie voles. Society for Neuroscience meeting, Atlanta, GA, October, 2006.

Ono S and Mustari MJ. Smooth pursuit adaptation after muscimol inactivation of dorsolateral pontine nucleus (DLPN) of macaques. Society for Neuroscience meeting, Atlanta, GA, 2006.

Papazoglou, A., King, T., Gessner, S., Morris, R., & Krawiecki, N. Age at diagnosis of childhood brain tumor predicts

parent report of behavior problems. American Academy of Clinical Neuropsychology, Denver, CO, June, 2007.

Papazoglou, A., King, T., Morris, R., & Morris, M. Cognitive Predictors of Adaptive Functioning in Children with Tumors of the Cerebellar and Third Ventricle Regions. Psychosocial and Neurocognitive Consequences of Childhood Cancer: A symposium in tribute to Raymond Mulhern, Memphis, TN, September, 2006.

Papazoglou, A., King, T., Morris, R., Henrich, C., Morris, M. & Krawiecki, N. Attention mediates radiation's impact on adaptive functioning in children with brain tumors. International Neuropsychological Society, Portland, OR, February, 2007.

Papazoglou, A., King, T., Partridge, J., Morris, R., & Krawiecki, N. Behavior problems as predictors of later adaptive functioning in children with brain tumors. International Neuropsychological Society, Portland, OR, February, 2007.

Parr, L.A. Advancing the classification of chimpanzee facial expressions. International Society for Research on Emotion, Symposium on Emotional Expression in Nonhuman Primates, Atlanta, GA, August 5-10, 2006.

Parr, L.A. & Heintz, M. Face recognition in nonhuman primates: Relevance for social cognition and theory of mind. Symposium on Theory of Mind, International Primatological Society, Entebbe, Uganda, June 25-30, 2006.

Parr, L.A. Categorization of facial expressions by chimpanzees. The Chimpanzee Mind, Lincoln Park Zoo, Chicago, IL, March 23, 2007.

Parr, L.A. Emotional communication in primates. The Biology of Social Cognition, Cold Springs Harbor Research Institute, Cold Springs Harbor, NY, July 13-20, 2006.

Parr, L.A. Evolution of social cognition. Sackler Colloquium, National Academy of Sciences, Irvine, CA, November 17 -18, 2006.

Paul, K.N. "Animal Models to Investigate Sex Differences in Sleep." Biology Seminar Series, Morehouse College, Atlanta, GA, 2006.

Paul, K.N. "Animal Models to Investigate Sex Differences in Sleep." Scientific Workshop on Women and Sleep, National Sleep Foundation, Washington, DC, 2007.

Paul, K.N. "Associative Analysis of Sleep and Activity." Sleep Research, Merck & Co., Inc., West Point, PA, 2006.

Paul, K.N. "Diurnal Sex Differences in the Sleep-Wake Cycle are Dependent on Gonadal Control." UNCF-Merck Science Initiative Fellows Day, Normandy Farms, West Point, PA, 2006.

Paul, K.N. "Gender and Sleep, From Bench to Bedside." Gender and Sleep Symposium, Annual Meeting Associated Professional Sleep Societies, Salt Lake City, UT, 2006.

Paul, K.N. "Sex Differences in the Sleep-Wake Cycle." Biology Seminar Series, Georgia State University, Atlanta, GA, 2006.

Paul, K.N. "Sleep under normal and challenge conditions: The impact of genes and gender." Circadian Rhythms and Sleep Disorders Symposium, Morehouse School of Medicine, Atlanta, GA, 2007.

Paul, K.N. "Sleep-Wake Architecture Exhibits a Genetic Relationship to Daily Fluctuations of Locomotor Activity." Neuroscience Seminar Series, Texas A & M University, College Station, TX, 2006.

Paul, K.N., Losee-Olson, S., Turek, F.W. Hormone Replacement Restores Sex Differences in the Sleep-Wake Architecture of Mice. 21st Annual Meeting Associated Professional Sleep Societies, Minneapolis, MN, 2007.

Paul, K.N., Losee, M.W., Simkin, D., Turek, F.W., Shelton, J. Sleep-Wake Architecture Exhibits a Genetic Relationship to Daily Fluctuations of Locomotor Activity. 20th Annual Meeting Associated Professional Sleep

Societies, Salt Lake City, UT, 2006.

Payne, C.D., Machado, C.J., Jackson, E.F. and Bachevalier, J. The maturation of the nonhuman primate amygdala: A Magnetic Resonance Imaging study. Society for Neuroscience meeting, Atlanta, GA, 2006.

Petridis, A., Barrett, N., & Washburn, D. Gender Differences in Stress Changes during a Decision-Making Task. Poster presented at the Georgia State University Psychology Undergraduate Research Conference, Atlanta, GA, March, 2007.

Philipp, M. C., & Owren, M. J. Voiced laughter elicits more positive affect than unvoiced laughter. Society for Psychophysiological Research Conference, Savannah, GA, 2007.

Philipp, M. C., & Vanman, E. J. Psychophysiological Measurements Can Serve As Valid Markers of Affect in Immersive Virtual Environments. Society for Psychophysiological Research Conference, Vancouver, BC, 2006.

Philipp, M. C., & Vanman, E. J. The effects of avatar presence and emotional valence on facial muscle activity in an immersive virtual environment. Society for Psychophysiological Research Conference, Savannah, GA, 2007.

Pirkle C, Snell TW, Kubanek J. Effects of harmful algae on rotifer feeding behavior and reproduction: Karenia brevis uses chemical defense to deter grazers. Poster presentation, International Conference on Harmful Algae, Copenhagen, Denmark, 2006.

Preuss, T.M. Invited Lecture, Department of Neurobiology, Yale University, New Haven, CT, May 24, 2007.

Preuss, T.M. Organizer and speaker, "The New Comparative Biology of Human Nature," National Academy of Sciences Sackler Symposium, Irvine, CA, November 16-18, 2006.

Preuss, T.M. Participant and speaker. Conference on "Genetics, Evolution, and Cognitive Ability and Intelligence, Stanford Center for Biomedical Ethics/Center for Integration of Research on Genetics and Ethics, June 11-12, 2007.

Prince EK, Myers T, Kubanek J. Dynamic allelopathic interactions among marine phytoplankton. Poster presentation, Gordon Research Conference on Marine Natural Products, Ventura CA, 2006.

Prince EK, Myers T, Naar J, Kubanek J. Species-specific allelopathic interactions involving the red tide dinoflagellate Karenia brevis. Poster presentation, International Conference on Harmful Algae, Copenhagen, Denmark, 2006.

Prince EK, Myers TL, Naar J, Kubanek J. Competing phytoplankton undermine allelopathy of Karenia brevis, the red tide dinoflagellate. Oral presentation by EK Prince, American Society of Limnology & Oceanography, Santa Fe NM, 2007.

Rainnie, D.G. Modification of Spike-Timing Precision by Inhibitory Synaptic Input and its Implications for Synaptic Plasticity. Gordon Research Conference on The Amygdala In Health and Disease, Maine 2007.

Rainnie, D.G. Strange Attractors: The Amygdala and Depression, George Washington University, School of Medicine, 2007.

Ramayya, A., Glasser, M., Hopkins, W., Preuss, T., and Rilling, J. A comparative diffusion tensor imaging (DTI) study of tool use pathways in humans, apes and monkeys. Organization for Human Brain Mapping (OHBM) Annual Meeting, Chicago, IL, June 10-14, 2007.

Raper, J. R., Stephens, S. B. Z., Wallen, K. Matrilineal Manipulations Surrounding Power Shifts in Socially Housed Groups of Rhesus Macaques (Macaca Mulatta). 29th Annual Meeting of the American Society of Primatologists, San Antonio, TX, August 16-19, 2006.

Richards MD, Wong AM, Foeller P, Bradley D, Tychsen L. Duration of binocular decorrelation predicts the intensity of fusion maldevelopment (latent) nystagmus in strabismic macaque monkeys. Annual Meeting of the Association

for Research in Vision and Ophthalmology (ARVO), 2006.

Robins, D.L. & Wiggins, L.D. Excluding the ADI-R behavioral domain improves diagnostic agreement with observation-based methods in toddler evaluations. International Meeting for Autism Research, Seattle, WA, May, 2007.

Rogge, G.A., Moffet, M.C., and Kuhar, M.J. Binge Cocaine Administration Increases CREB Binding to the CART Gene CRE Cis-Regulatory Element in the Rat Nucleus Accmbens. Society for Neuroscience, Atlanta, GA, 2006.

Rosen, R.F., Farberg, A.S., Long, P., Gearing, M., Anderson, D., Coppola, G., Geschwind, D., Pare, J., Hopkins, W., Preuss, T.M., and Walker, L.C. Tauopathy with paired helical filaments in a chimpanzee. Society for Neuroscience Annual Meeting, San Diego, CA, November 4-8, 2007.

Ross JD, Reddy NE, Bakkum DJ, Potter SM, DeWeerth, SP. "Experimental platform for the study of region specific excitation and inhibition in neural tissue". IEEE EMBS Conference, Lyon, France, 2007.

Ross, H.E., Petrulis, A., Murphy, A.Z. and Young, L.J. Mapping olfactory circuitry in prairie voles using an transneuronal viral tracer. Soc. Behavioral Neuroendocrinology meeting, Monterey, CA, 2007.

Ryan, J. P., Mirez, D. S., Vanman, E. J. Primes and Prejudice: Race of the participant moderates the relationship between subliminal priming of race and facial muscle activity. Poster presentation at the meeting of the Society for Psychophysiological Research, Vancouver, BC, 2006.

Sanchez, M., McCormack, K.M., Ely, T., Lyon, C.K., Boudreau, M., Noble, P.M., Parr, L.A., Nemeroff, C.B., Winslow, J.T., Votaw, J.R., Goodman, M. & Kilts, C.D. Repeated maternal separation alters the development of brain serotonergic function in rhesus monkeys. Society for Neuroscience meeting, Atlanta, GA, October 14-20, 2006.

Sanchez, M.M., Alagbe, O., Copp, B., Zhang, X., Felger, J., Zhang, J., Graff, A., Grand, A., Maestripieri, D., Miller, A. Infant maltreatment has long-term effects on neurobiology and inflammatory signaling of juvenile rhesus monkeys (M. mulatta). 38th Annual Conference of the International Society of Psychoneuroendocrinology (ISPNE), Madison, Wisconsin, August, 2007.

Sangha, T.S., S. Freeman, R. C. Liu. Mouse love songs? Male and female behavior during courtship. Emory Undergraduate Research Symposium, Atlanta, GA, April 11, 2007.

Sarver, J.P. Denton, M.K. and Blumer L.S. A Methanol-Free Method of Extracting Secondary Chemicals, Invited Poster , 29th Annual Meeting of the Association for Biology Laboratory Education, University of Kentucky, Lexington, KY, 2007

Sathian, K., E.L. Mariola, R.F. Stilla & M. Zhang. Widespread decreases in cerebral cortical activation during tactile perception in Parkinson's disease. Society for Neuroscience Meeting, Atlanta, GA, 2006.

Sawaki, L., X. Leng, A.J. Butler, P.A. Wassenaar, Y. Mohammad, S. Blanton, K. Sathian, D.S. Nichols, S.L. Wolf, D.C. Good & G.F. Wittenberg. Motor map plasticity in constraint induced therapy for stroke. International Stroke Conference, 2007.

Sawyer, N.T., & McCormack, K. An investigation of HPA axis activity and social aggression in abused and non-abused male adolescent rhesus macaques. Faculty for Undergraduate Neuroscience (FUN) symposium, Society for Neuroscience, Atlanta, GA, October, 2006.

Schroth, E. A., Parrish, J. M., Leibenluft, E., Pine, D. S., & McClure, E. B. Sex Differences in Adolescent Responses to Evaluative Feedback Cues. Association for Psychological Science 19th Annual Convention, May, 2007.

Schwarb, H., & Schumacher, E. H. Dissociating the neural mechanisms for procedural skill and sequence learning using functional neuroimaging. Poster presented at the annual meeting of the Cognitive Neuroscience Society, New York, NY, May, 2007.

Schwarb, H., & Schumacher, E. H. The effect of dual-task processing overlap on sequence learning. Poster presented at the annual meeting of the Psychonomic Society, Houston, TX, November, 2006.

Scrivens, J. E., Ting, L. H., & DeWeerth, S. P. Scaling of Feedback Control Gains with Stance Width. IEEE Engineering in Medicine and Biology Conference, New York, NY, 2006.

Scrivens, J., DeWeerth, S. P., & Ting, L. H. Increased stance width necessitates decreased feedback gain in a bipedal model of postural control, Society for Neuroscience Annual Meeting. Atlanta, GA, 2006.

Seibyl J, Goodman MM, Koren A, Stehouwer JS, Jennings D, Staley J, Tamagnan G, Preclinical and Clinical Characterization of 123-I mZIENT, a Marker of Serotonin Transporter Density, J Nuc Med, 48(S2)113P, 2007.

Sharma, R., Barrett, N., Ryan, J.P. & Washburn, D.A. The effects of gender on pupil dilation to Ethnic faces. GSU Psychology Undergraduate Research Conference, Atlanta, GA, March, 2007.

Shelton, L., Barrett, N., & Washburn, D. The Effects of Environmental Music Conditions on Verbal Short-Term Memory. Poster presented at the Georgia State University Psychology Undergraduate Research Conference, Atlanta, GA, March, 2007.

Sin L, Wong AM, Foeller P, Bradley D, Tychsen L. Duration of binocular decorrelation predicts the angle of infantile strabismus in macaque monkeys. Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO), 2006.

Snyder, R.J., Hogan, B., Wilson, M.L., Lawson, D.P., Zhang, Z.H., Luo, L., Li, C.L., and Maple, T.L. Giant panda mother-cub play-fighting: sex differences and targets of attack. Annual meeting of the Giant Panda Technical Breeding Committee, Chiangmai, Thailand, November, 2006.

Song, C. K. and Bartness, T. J. Central projections of the sensory nerves innervating brown adipose tissue. Society for Neuroscience, San Diego, CA, 2007.

Stanek-Rattiner, L., Moffett, M., and Kuhar, M.J. Creation of a Lenti Viral Vector to Overexpress Cocaine- and Amphetamine-Regulated Transcript (CART) Peptide. Society for Neuroscience, Atlanta, GA, 2006.

Stansbury, Kathy, and David W. Haley. Breastfeeding, Socioeconomic Status, and Individual Differences in Maternal Care, and Their Relation to Infant Cortisol. Biennial Meetings of the Society for Research, Boston, Massachusetts, April 2007.

Stehouwer JS, Chen P, Voll RJ, Williams LA, Votaw JR, Howell LL, Goodman MM, PET Imaging of the Dopamine Transporter with (18F)BFNT, J Labelled Comp and Radiopharm, 50(S1) S335, 2007.

Stilla, R.F., E.L. Mariola & K. Sathian. Haptic and multisensory selectivity for texture and shape in cerebral cortex. Society for Neuroscience Meeting, Atlanta, GA, 2006.

Taylor, S. Lin, and Huhman, K.L. Activation of GABA A receptors in the ventral but not dorsal hippocampus reduces the acquisition of conditioned defeat in male Syrian hamsters. Society for Behavioral Neuroendocrinology, Pacific Grove, CA, 2007.

Thompson AL, Whitten PL, Lampl M. Feeding, hormones and body composition: a reproductive ecological approach to the study of infant growth. American Journal of Physical Anthropology 132(S44): 231, 2007.

Thompson, KJ. Pre-genital ganglia as useful preparations for central pattern generation studies in grasshoppers. International Society for Neuroethology, 8th Congress, Vancouver, BC. July 23, 2007.

Todd, J., Clemens S., and DeWeerth S.P. Intracellular recording reveals that extracellular electrical stimulation can cause enduring dynamic changes of cellular properties. Society for Neuroscience Meeting. Atlanta, GA, 2006.

Toldson IA, Neill DB. Navigating the Maze: Using Animal Models of Addiction to Explain Drug Vulnerability in Distressed Communities. Annual Meeting of the Association for Behavioral Analysis, San Diego, CA, August, 2007.

Toufexis DJ, Myers KM, Davis M. Opposing actions of ERa and ERb activation cause a learning deficit in gonadectomized female, but not male, rats in an aversive discrimination learning paradigm. Poster presented at the 36th annual meeting of the Society for Neuroscience, Atlanta, GA, 2006.

Tunaru, S., Vicentic, A., Hubert, G.W., Kuhar, M.J., and Hall R.A. Cross-Linking of Cocaine- and Amphetamine-Regulated Transcript (CART) to AtT20 Cells: A Biochemical Approach to Isolate and Identify the CART Receptor. Society for Neuroscience, Atlanta, GA, 2006.

Vanman, E. J., & Philipp, M. C. Looking at pictures next to avatars: The effects of social context and emotional valence on facial muscle activity in an immersive virtual environment. International Society for Research on Emotions, Sunshine Coast, Queensland, AU, 2007.

Vasudeva RK, Okere CO, Waterhouse BD. Serotonin-1A receptors are located on nitric oxide synthase-containing neurons throughout the dorsal raphe nucleus. Society for Neuroscience, Atlanta, GA, 2006.

Vaughan, C. H., Song, C. K. and Bartness, T.J. Central melanocortin involvement in brown adipose tissue (BAT) thermogenesis. North American Society for the Study of Obesity, New Orleans, LA, 2007.

Vaughan, C. H., Song, C. K., Keen-Rhinehart, E. and Bartness, T. J. Effects of central melanocortin administration on brown adipose tissue (BAT) thermogenesis. Society for the Study of Ingestive Behavior, Steamboat Springs, Co, 2007.

Vollmar, I., R. C. Liu, G. Kempermann. Communication, music and adult neurogenesis, International Max Planck Research School Spring Academy 2007, Harnack-House, Berlin, Germany, May 21-25, 2007.

Vytal, K.E., Epstein, C. M., Ehrenberg, J. A., & Hamann, S. B. Emotional Memory Disruption Following Prefrontal Transcranial Magnetic Stimulation . Cognitive Neuroscience Society annual meeting, New York, NY, May, 2007.

Wallen K. Behavioral sex differences in primates: Hormones, timing, and predispositions, Behavioral Neuroscience Distinguished Lecture, Michigan State University, East Lansing, MI, Sept 19, 2006.

Wallen K. Estrogens, androgens, and primate female sexual desire. Neurobiology Colloquium, Rockefeller University, New York, NY, March 12, 2007.

Wallen K. Sex differences in primates: Boys, noise, and toys, Behavioral Neuroscience Colloquium Series, Indiana University, Bloomington, IN, January 18, 2007.

Walthall, Bill, Jennifer Gibbs, Eric Stewart, Keyur Vora and Gennady Cymbalyuk, Inhibitory motoneurons are crtitical for backward but not forward locomtion. 16th International C. elegans meeting, Los Angeles, CA, 2007.

Wang, B. “Selective PDE4 Inhibitors.” 5th Biennial Chinese Medicinal Chemistry Symposium, November 2-7, 2006.

Wang, B. Department of Chemistry, Louisiana State University, September 15, 2006.

Wang, B. Department of Chemistry, State University of New York-Buffalo, December 8, 2006.

Wang, B. Department of Chemistry, University of South Florida, Tampa, Florida, Jan 11, 2007.

Wang, B. Valdosta State University and ACS-South Georgia Section, November 27, 2006.

Wang, B. World Precisions, Sarasota, Florida, Jan 12, 2007.

Wang, B.. “Selective PDE4 Inhibitors for Asthma Treatment.” Second MBD Day Symposium, Georgia State University, May 18, 2007.

Washburn, D. A., & Barrett, N. Hemispheric Differences in the Prediction of Inattention Using Transcranial Doppler Sonography. Poster presented at the annual meeting of the Society for Neuroscience, Atlanta, GA, October, 2006.

Washburn, D. A., & Rumbaugh, D. M. History of the Language Research Center. Invited paper in the symposium “History of Animal Psychology in the South,” Annual meeting of the Southeastern Psychological Association, New Orleans, LA, March, 2007.

Washburn, D. A., Barrett, N., Matthews, G., & Warm, J. Being Vigilant to Homeland Security. Paper presented in Presidential invited symposium “Psychology in the public interest of homeland security,” Annual meeting of the Southeastern Psychological Association, New Orleans, LA, March, 2007.

Washburn, D. A., Beran, M. J., Evans, T. A., & Klein, E. D. Domain Specificity in Inhibition of Responding by Macaques. Poster presented at the annual meeting of the Psychonomic Society, Houston, TX, November, 2006.

Wheeler, M.G., and D. Neill. Antagonism of GABAergic transmission in ventral pallidum decreases response efficiency in a DRL-10 sec schedule. Society for Neuroscience meeting, San Diego, CA, 2007.

Whitten PL, Turner TR. Female reproductive state, ecology, and serum leptin in wild vervet monkeys (Chlorocebus aethiops). American Journal of Physical Anthropology 132(S44): 248, 2007.

Wiggins, L.D. & Robins, D.L. Multi-level screening efforts with the Modified Checklist for Autism in Toddlers and the Screening Tool for Autism in Two-Year-Olds. International Meeting for Autism Research, Seattle, WA, May, 2007.

Wiggins, L.D., Robins, D.L., Bakeman, R., & Adamson, L.. Sensory abnormalities as distinguishing symptoms of autism spectrum disorders. Georgia Psychological Association meeting, Atlanta, GA, May, 2007.

Williams, K, S LaConte, S Peltier, S Keilholz. Investigating the influence of anesthesia on resting state connectivity in rats using multiple analysis techniques. 15th Annual ISMRM, Berlin, 2007.

Yang, Jenny. 14th Congress of Calcium-binding Proteins and Calcium Function in Health and Disease, La Palma, Canary Island, Spain Oct. 16, 2007.

Yang, Jenny. College of Life Science, Zhejiang University, Hanzhou, China, July 19, 2007.

Yang, Jenny. Department of Cellular Biology and Anatomy, Medical College of Georgia, August 16, 2007.

Yang, Jenny. Department of Chemistry, University of Akron, OH, October, 25, 2006.

Yang, Jenny. Huazhong Science and Technology University, Wuhan, China, July 23, 2007.

Yang, Jenny. Institute of Materia Medica, Chinese Academy of Medical Science & Peking Union Medical College, Beijing, R. China, Jan.9, 2007.

Yang, Jenny. Institute of Medica Biotechnology, Chinese Academy of Medical Science & Peking Union Medical College, Beijing, R. China, Jan.10, 2007.

Yang, Jenny. Janelia Conference of Fluorescence Proteins and Biosensors, Howard Hughes medical Institute, Janelia Farm Research Campus, October 28, 2007.

Yang, Jenny. Molecular Bases of Diseases symposium, Atlanta, GA, May, 8, 2007.

Yang, Jenny. Nano-biotechnology Conference, The Third Military Medical University, Chongqing, China, Jan. 13-4, 2007.

Yang, Jenny. National Analytical Research Center of Electrochemistry and spectroscopy, Changchun Institute of Applied Chemistry Chinese Academy of Sciences (CIAC), Changchun, China, Jan.8, 2007.

Yang, Jenny. The Medical School, the Florida State University, Tallahassee, FL, April 25, 2007.

Yang, Jenny. Wuhan Institute of Physics and Mathematics The Chinese Academy of Sciences, Wuhan, July 24, 2007.

Young, Larry. 6th Annual Conference on Neuroesthetics: The Neurobiology of Love. Berkeley California, January, 2007.

Young, Larry. Biochemistry, Cell Biology, Development Annual Symposium: The Science of Sex. Emory University, Atlanta, GA, March, 2007.

Young, Larry. Genetics and Genomics of Social Behavior. An NIH workshop. Bethesda Md, January, 2007.

Young, Larry. Invited speaker. Grand Rounds, Columbia University Department of Psychiatry, New York, NY, July, 2007.

Young, Larry. Invited speaker. International Meeting for Autism Research, Seattle WA, May, 2007.

Young, Larry. Invited speaker. International Society for Neuroethology. Vancouver Canada, July, 2007.

Young, Larry. Invited speaker. Oregon Heath Sciences Center, Department of Physiology and Pharmacology Seminar Series. Portland Oregon, March, 2007.

Young, Larry. Invited speaker. Parental Brain Conference. Boston MA, June, 2007.

Young, Larry. Invited speaker. Princeton University, Neuroscience Program Seminar Series, March, 2007.

Young, Larry. Invited speaker. The New Comparative Biology of Human Nature. An Arthur M. Sackler Colloquia of the National Academy of Sciences. Irvine CA, November, 2006.

Young, Larry. Invited speaker. University of Maryland, Baltimore Program in Neuroscience Seminar, January, 2007

Young, Larry. The Biology of Prosocial Behavior. The Consulate of Switzerland and University of Zurich. Cambridge, Mass, March, 2007.

Young, Larry. The Montreal Children's Hospital, Division of Child Psychiatry, McGill University. Research Day 2007- Animal Models of Behavior. Montreal, Canada, May, 2007.

Young, Larry. Translational Workshop with Eric Hollander: Translational approaches in Autism Research, July, 2007.

Young, Larry. University of Washington Program in Neuroscience Seminar Series. Seattle, Washington, May, 2007.

Young, Larry. Workshop: Novel Translational Research to Treat Social and Communicative Deficits in Autism. Institute of Creative Technologies, Univ. Southern California. Marina del Rey, CA, August, 2006

Yu W, Camp VM, Goodman MM, Biological Evaluation of Syn/Anti-[18F]FMACBC for PET Tumor Imaging, J Nuc Med, 48(S2) 342P, 2007

Yu W, Camp VM, Goodman MM, Synthesis and Characterization of gem-(123I)VACBC as a Potential SPECT Tumor Imaging Agent, J Labelled Comp and Radiopharm, 50(S1) S428, 2007.

Zeamer, A.E., Resende, M., Heuer, E. and Bachevalier, J. The development of infant monkeys' recognition memory abilities in the absence of a functional hippocampus. Society for Neuroscience meeting, Atlanta, GA, 2006.

Zeng F, Jarkas N, Stehouwer JS, Voll RJ, Williams LA, Votaw JR, Goodman MM, Synthesis and Evaluation of (S,S)-(11C)METREBOX As a Norepinephrine transporter Imaging Agent, J Labelled Comp and Radiopharm, 50(S1) S290, 2007.

Zeng F, Jarkas N, Stehouwer JS, Williams LA, Votaw JR, Kilts CD, Nemeroff CB, Goodman MM, 18F-Labeled Analogs of Reboxetine as PET Imaging Agents for Norepinephrine Transporters, J Nuc Med, 48(S2)301P, 2007.

Zola, S. A Simple Behavioral Task Combined with Noninvasive Infrared Eye-Tracking for Examining the Potential Impact of Vaccines on Memory and Other Cognitive Functions. Novel Vaccines, Targeted Immunotherapeutics and Vaccines Conference, Boston, MA, August, 2007.