

b. Executive Summary

The Center for Behavioral Neuroscience started officially November 1, 1999. Major goals for the first year of the Center's operation were developing a strategic plan, establishing an administrative team, and beginning the research, educational, and knowledge transfer thrusts. Critical for the initial phase of the Center's development as an inter-institutional program, we created a Website (www.cbn-atl.org) and via LearnLink connected all faculty at the participating institutions to a central electronic interface for communication.

The strategic plan, completed 2/00, detailed the vision, goals, and performance indicators for the Center. We recruited an administrative team, including deputy directors, administrative assistants at Emory and Georgia State, and a financial manager. At each institution, additional faculty who were not part of the original proposal joined the Center. In addition, three major new faculty members were recruited from outside: Drs. Muly, Rainnie, and Parent. An appendix includes biosketches for these new faculty recruited from within and from outside CBN institutions. Additional searches are underway for behavioral neuroscientists at Emory University, Georgia State University, and Morehouse College. We now have a process for recruiting and reviewing faculty and post-doctoral fellows.

In the first year, we note progress on each of the main thrusts.

In research, collaboratories have been developed in two areas: (a) fear and aggression and (b) affiliation and reproduction. Each collaboratory has held a series of meetings to discuss shared interests. In February, we began a monthly evening seminar series featuring state-of-the-art talks relevant to behavioral neuroscience. A retreat (5/00) brought together over 40 investigators representing all of the participating schools. In June, we funded the first 10 venture grants based on collaborative projects between Center laboratories. In July the first post-doctoral fellows began, linking each collaboratory to a core. Three additional post-doctoral fellow candidates will be interviewing this summer. Although it is too early to report results based on collaboratory research, collaboratory scientists published papers in *Journal of Neuroendocrinology*, *Hormones and Behavior*, and *Nature Genetics* acknowledging affiliation with the Center.

An important aspect of Center research is the development of tools for behavioral neuroscience. Cores were established for Molecular, Cellular, Systems, Computational, Imaging, and Behavioral studies. With the assistance of the Georgia Research Alliance, the Molecular Core developed a microarray production facility, managed by Dr. Scott Hemby. The Cellular Core, with the assistance of Dr. Stuart Leff, began producing adeno-associated viruses for gene delivery. Dr. Ioannis Constantanidis of the Imaging Core rebuilt a 4.7T NMR to use for small animal fMRI. In addition, the Imaging Core is awaiting arrival of a 3T magnet for fMRI and a MicroPET camera for small animal functional and receptor imaging. Finally, with support of the Georgia Research Alliance we began a renovation of laboratory space for the CBN at Georgia State.

The Educational thrust has been able to build on several existing programs to demonstrate rapid progress. Committees for pre-college, undergraduate, and graduate education developed specific goals and strategies related to minority recruitment and education. In our first summer, 5 teachers and 10 undergraduate students worked in behavioral neuroscience labs. The CBN helped to sponsor three workshops for Atlanta Public School teachers. An undergraduate committee developed a new fellowship in behavioral neuroscience, designed new courses, and planned a BS/MS program to recruit more minority candidates for graduate work in neuroscience. A graduate program has been designed for behavioral neuroscience, with our first two students entering in September, 2000.

Our knowledge transfer component not only developed our website but provided LearnLink accounts and training to all participants in the CBN. To augment internal communications, we have started a quarterly newsletter, the CBN Synapse. The CBN has initiatives in public education with SciTrek, a local science museum, as well as plans to participate in Brain Awareness Week. The CBN was announced by articles in the Atlanta Journal Constitution, Atlanta Business Chronicle, and APA Monitor as well as through presentations on public radio (the Paula Gordon Show) and to the Southeast University Research Association and the Board of Directors of the Atlanta Commerce Club. Finally, the CBN has developed a draft intellectual property agreement designed to provide a revenue stream to the Center for discoveries originating in CBN labs.

We are still in the early phases of our development. Indeed, NSF signed the Cooperative Agreement only in May and, as of 7/31/00, subcontracts have been signed by only 2 of the 7 institutions. So the CBN is still very much a work in progress. We recognize that there are many challenges but we also are enthusiastic about the many opportunities we have to develop an innovative program in behavioral neuroscience.

c. Research Accomplishments and Plans

There are two general thrusts to the research program of the CBN. The focus on the neurobiology of social behavior is being developed in two collaboratories, each of which involves investigators from the various CBN institutions. The development of these collaboratories is, by itself, an experiment in a new model for interdisciplinary science. This first year was spent largely in developing this concept through meetings and venture projects. The second thrust is the core program, developing research tools that support the collaboratory effort. As many of the technical needs were evident in the original proposal, the cores have jumped ahead to develop a number of critical technologies. The Center has benefited from new space. At the Yerkes Research Center, the CBN has occupied a new research floor housing the labs and offices of Drs. Young, Insel, and Wilson as well as the Molecular and Cellular cores. A new rodent vivarium serves this part of the CBN. At Georgia State University, a \$385,000 renovation of lab space for the CBN is underway, supported by the Georgia Research Alliance.

Progress and Plans of the Collaboratories **Fear /Aggression Collaboratory (leaders in bold)**

Elliott Albers, Ph.D. - Georgia State University

Michael Davis, Ph.D. – Emory University

Charles Derby, Ph.D. - Georgia State University

Donald Edwards, Ph.D. - Georgia State University

Melissa Harrington, Ph.D. – Morehouse College

Kim Huhman, Ph.D. - Georgia State University

Paul Katz, Ph.D. - Georgia State University

Grant MacGregor, Ph.D. – Emory University

Tim Moore, Ph.D. – Clark Atlanta University

Robin Morris, Ph.D. - Georgia State University

Paul Plotsky, Ph.D. – Emory University

Barbara Rothbaum, Ph.D. – Emory University

James Winslow, Ph.D. – Emory University

Post-doctoral fellow: Lisa Parr, Ph.D. - Emory University

Affiliation/Reproductive Behavior Collaboratory (leaders in bold)

Chris Beck, Ph.D. – Emory University

Lawrence Blummer, Ph.D. – Morehouse College

Frans de Waal, Ph.D. – Emory University

David Dusenberry, Ph.D. – Georgia Tech

Lorin Freedman, Ph.D. – Emory University

Thomas Insel, Ph.D. – Emory University

Sean Kimbo, Ph. D. – Clark Atlanta University

Jeanne Stahl, Ph.D. – Morris Brown College

Kim Wallen, Ph.D. – Emory University

William Walthall, Ph.D. - Georgia State University

Patricia Whitten, Ph.D. – Emory University

Mark Wilson, Ph.D. – Emory University

Larry Young, Ph.D. – Emory University

Tong Zhou, Ph.D. – Georgia Tech

Post-doctoral fellow - Steve Phelps, Ph.D. - Emory University

During the first year, the CBN collaboratories have reorganized their research themes, promoted interdisciplinary discussions, and launched the first generation of collaborative studies. Currently, the two collaboratories are (a) Fear and Aggression and (b) Affiliation and Reproduction. Each held several meetings to discuss areas of focus and collaborative projects. At a general retreat, each collaboratory member presented a few slides discussing his or her work. Following the presentations, faculty broke off into smaller groups to discuss plans for collaborations and potential applications for venture funding. In April, a total of 16 venture grants were submitted, 10 of which were funded for cross-laboratory research or educational projects (see Appendix 7). In addition, several other collaborative projects have been initiated which are supported through collaboratory funds. For example, Dr. Elliott Albers and Dr. Larry Young have been collaborating on a project involving using an adenoviral vector expressing the vasopressin receptor that Dr. Young developed to investigate the neural circuitry involved in hamster flank marking behavior.

During the next year, we will use collaborative meetings to discuss directions for projects and to further refine the focus. From our experience this first year, we believe that post-docs and students will serve as vectors for collaboration across labs. In addition, the venture grants provide an incentive that brings investigators together. The second round of venture grants will be submitted in November. We predict that the quality, quantity, and originality of the venture grant proposals will increase as the interaction between the faculty grow and core resources, such as microarrays and imaging, become available.

Progress and Plans of the Cores

In our first year, the CBN cores faced two major challenges. First, each core had to be developed. In some cases, such as the Molecular Core and Imaging Core, this development leveraged an effort already initiated by another program. In other cases, we needed (and still need) to recruit technical support to drive this effort. And in still other cases, such as the Computational Core, we postponed development until we had a better sense of the needs. Which raises the second challenge. For most of these cores, the opportunity is still greater than the CBN faculty's interest. We held a core workshop to present the power of microarrays, viral vectors, and small animal imaging, but the CBN needs to invest a more prolonged effort to ensure that the faculty understand the potential and the limitations of the techniques under development.

Molecular Core

Steve Warren, Ph.D. - Emory University (Biochemistry)

Scott Hemby, Ph.D. - Emory University (Pharmacology)

Grant MacGregor, Ph.D. - Emory University (Genetics)

Kim Gernert, Ph.D. - Emory University (BIMCORE)

The Molecular Core has spent its first year developing a microarray facility for CBN investigators. In the initial venture grant submissions, microarrays were the most frequently requested technology by CBN investigators. Accordingly, along with GRA support, Dr. Scott Hemby of the CBN has equipped a 600 sq.ft. laboratory with a bank of PCR machines and DNA sequencers for validating clones, high throughput robotics for printing arrays, and a confocal laser scanner for array analysis. A laser capture microscope will assist with tissue sampling. Dr. Hemby has purchased 40,000 human and 15,000 rat and mouse clones for developing the first neuroendocrine array. A molecular biologist, Dr. Yu-Hua Li, has recently joined the Molecular Core to assist CBN faculty specifically with developing custom arrays. Due to the heavy demand for services from CBN faculty, the Core plans to hire a technician to assist with venture grant projects. In this first year, the Core's Dr. Kim Gernert taught an introductory bioinformatics course attended by several CBN faculty from Emory and Morehouse School of Medicine.

Cellular Core

Allan Levey, M.D., Ph.D. - Emory University (Neurology)

Stuart Leff, Ph.D. - Emory University (Yerkes)

Michael Kuhar, Ph.D. - Emory University (Pharmacology)

Larry Young, Ph.D. - Emory University (Psychiatry)

The Cellular Core has been established adjacent to the Molecular Core in a new research building at the Yerkes Center. This Core has focused its initial efforts on viral vector development. Dr. Stuart Leff, an expert on adeno-associated virus (AAV), has spent this first year developing constructs and neuron-specific promoters as well as optimizing protocols to improve viral purity and titer. In addition, the Core has begun working with lentiviral vectors. Constructs of interest include genes for neurotransmitter synthesizing enzymes as well as receptors and transporters. In the next year, we expect the Core to develop a series of vectors for use by CBN faculty. In addition, this Core will begin to address needs for a proteomics approach analogous to the genomics effort in the Molecular Core.

Systems Core

Michael Crutcher, Ph.D. - Emory University (Neurology)

Timothy Bartness, Ph.D. - Georgia State (Biology)

The Systems Core was charged originally with developing ensemble (multi-channel) recording and telemetry as well as providing opportunities to use viruses for multi-synaptic, tract tracing. During the first year Dr. Lynn Enquist who is one of the leaders in the use of viruses for tract tracing visited the Center and met with a number of CBN investigators. Dr. Enquist has confirmed his interest in working with CBN investigators and is in the process of providing some material to the CBN. Together, he and Tim Bartness at Georgia State will provide ample expertise in this area. With regard to the ensemble recordings and telemetry we have faced two setbacks in our first year. A potential recruit, expert in multi-channel recording, has decided to take a job elsewhere and Rob Turner, our telemetry expert, was recruited away to UCSF. The Core is still committed to developing multi-channel recording and, with the Department of Neurology at Emory University School of Medicine, will continue to search for an expert in this area. Fortunately, the Department of Neurology hired Dr. Michael Decker to a faculty position. Dr. Decker is an expert in the development and use of telemetry and has agreed to work with the Systems core as needed to meet our needs in this area. In addition, in collaboration with others at the Georgia Institute of Technology Steve DeWeerth, head of the Computational Core, and Dr. Michael Crutcher, head of the Systems Core, are planning a major effort to develop chronically implantable, microminiature electrode arrays. Ultimately, the plan is to use cortical activity to drive peripheral devices. A federal grant has been submitted to the ONR for this project, with CBN participation on issues relevant to the cortex and behavior.

Imaging Core

Ernest Garcia, Ph.D. - Emory University (Radiology)

Greg Berns, Ph.D. - Emory University (Psychiatry)

Ioannis Constantinidis - Ph.D. - Emory University (Radiology)

Clint Kilts, Ph.D. - Emory University (Psychiatry)

Peter MacLeish, Ph.D. - Morehouse School of Medicine (Anatomy)

Victor Rehder, Ph.D. - Georgia State Univ. (Biology)

In this first year, the Imaging Core spent considerable time and money reconfiguring a 4.7T magnet for small animal imaging. Initial structural studies with rats and mice by Dr. Ioannis Constantinidis are promising, although protocols for functional studies still need to be developed. In addition, we are awaiting a new gradient coil to permit studies in

small primates. Other instruments purchased by Emory University including a 3T fMRI and a microPET camera should be available by the end of this calendar year. We are recruiting a research track assistant professor with fMRI experience to assist CBN faculty with their studies. In the meantime, Dr. Greg Berns of the CBN organized a 6 week course in principles of fMRI that was attended by several CBN investigators. Our goals for next year include not only a fully functioning small animal imaging program, but also educating the faculty about this resource.

Computational Core

Ron Calabrese, Ph.D. - Emory University (Biology)

Don Edwards, Ph.D. - Ga State Univ (Biology)

Steve DeWeerth Ph.D. - Ga Tech (CCE)

Although preliminary discussions have been held about the future directions of the computational core, we feel that more input from the CBN faculty is required before a firm direction is set.

Behavioral Core

Kim Wallen, Ph.D. - Emory University (Psychology)

Duane Rumbaugh, Ph.D. - Ga State Univ (Psychology)

Tong Zhou, Ph.D. - Ga Tech (Biology)

Ron Shafer, Ph.D. - Ga Tech (Biology)

As a result of discussions among CBN faculty it became clear that the Behavioral Core will have at least two major functions: 1) to provide access to techniques for behavioral analysis to all scientists in the Center, and 2) to develop new technologies for behavioral analysis that will serve the developing research program. First, the Core will to serve as a central clearinghouse for the many different types of expertise in behavioral analysis that currently exist in CBN laboratories. To address this need we have initiated the hiring of a technician for this core who will identify all the existing resources for behavioral analysis and develop mechanisms that will allow these resources to be shared among CBN laboratories. In addition, the technician will work with the faculty to identify areas where new expertise and equipment will be required. Second, the Core will work with CBN faculty as well as industrial partners to develop new approaches to the recording and analysis of behavioral data.

Accomplishments

While the CBN research effort is still in its infancy, several important projects deserve note. Our first Center publication, in the July, 2000 issue of Nature Genetics described the singular role of oxytocin in social recognition. This study, involving Drs. Winslow, Young, and Insel from Emory University, used a knock-out mouse to demonstrate that oxytocin is necessary for mice to learn their social partners. The importance of this study is that it provides a model for defining the neural circuits of normal social recognition. In ongoing work, the Fear/Aggression collaboratory has demonstrated that over-expression of the transcription factor CREB in the amygdala facilitates fear conditioning. This same approach is now being used to investigate conditioned defeat. Finally, in the Affiliation/Reproduction Collaboratory, the development of the first viral vectors is already providing important insights into the populations of receptors that are critical for social interaction in rodents.

d. Education and Human Resources

We have made significant progress on our first year goals as outlined in the education section of our Strategic Plan (www.cbn-atl.org). These accomplishments were made possible through the hard work of committees representing each institution in our collaboration and the NSF support that allowed the hiring of Dr. Danielle Gray as Assistant Director of the Education component, Mr. Gary Falcon as Technology Coordinator for the CBN, and Mr. Jordan Rose to support outreach to public education. At GSU, Dr. Melissa Demetrioukopolis was hired as a Neuroscience educator. Below we summarize these accomplishments under three categories: K-12 Initiatives, Undergraduate Programs, and Graduate Programs.

K-12 Initiatives

Specifically, for the K-12 initiatives we have:

- Established a coordinating council for the various K-12 programs related to Center for Behavioral Neuroscience
- Designed projects, workshops and curriculum units related to national and state standards with teacher input through the Georgia Industrial Fellowships for Teachers (GIFT) program
- Recruited 6 teacher summer interns into Center for Behavioral Neuroscience labs
- Planned and conducted teacher workshops on Problem Based Learning, Technology, BioQUEST and Behavioral Neuroscience
- Developed a workshop for teachers in molecular modeling with the support of Biomolecular Computing Resource at Emory (BIMCORE)
- Collaborated on several grant proposals.

GIFT 2000 (see appendix 8)

The Georgia Industrial Fellowships for Teachers (GIFT) continues to offer Atlanta area high school teachers invaluable opportunities to gain hands-on experience in academic, business and industrial environments during the summer. With funding from Howard Hughes Medical Institute and CBN, 15 math and science teachers were placed in various research positions for eight weeks (7, supported by CBN, in behavioral neuroscience labs). With the help of their partner scientists, GIFT participants identified ways to integrate their research with their classroom curriculum. CBN GIFT teachers will present their work at a closing symposium with undergraduate research students. We anticipate increasing the number of CBN GIFT teachers to 20 next year.

Teacher Workshops (see appendix 8)

Investigative Case-Based Learning (ICBL) is a way of teaching science that engages students in investigating realistic cases containing relevant problems. ICBL addresses several of the National Science Education Standards and AAAS Benchmarks. This summer, 20 teachers from the Atlanta Public Schools participated. This workshop actively engaged teachers in the materials and methods of ICBL. In addition, specific BioQUEST software simulations that work well with the cases were introduced. Participants wrote their own cases to fit within their current curriculum, identified likely learning resources and planned how to implement the cases in their own classes. The

workshop leaders stated that this was the most dedicated group of teachers they have worked with; workshop participants enthusiastically endorsed the practical lesson plans that they developed.

The molecular modeling workshop was conducted by Vincent Tolbert, a past GIFT fellow and currently a physics teacher at Frederick Douglass High School in the Atlanta Public School System. He instructed 13 teachers from Atlanta regional middle and high schools on the use of Rasmol, an interactive molecular graphics program intended for the visualization of proteins, nucleic acids and small molecules. Rasmol allows students to view, manipulate and construct proteins, nucleic acids, and small molecules three dimensionally. It provides students with the opportunity to understand current scientific resources that are used daily throughout the scientific community. Through this program, teachers learned how to teach students to create, modify, research, view, manipulate and construct the representation of proteins, nucleic acids and small molecules

The Diversity and Adaptations in the Brain workshop for 18 middle school teachers was conducted by Dr. Melissa K. Demetrikopoulis, of Georgia State University. This workshop used brain diversity as a way to expand upon the Life Science curriculum objectives for the state of Georgia. These participants will have access to the various brain specimens and other resources that we use in the workshop for their classroom. Building on this effort, we are setting up a lending library of neuroscience materials for the classroom. Much of this material will be used on the BioBus for an "Adaptation in the Brain" module to be transported to Atlanta public schools. In cooperation with Dr. Molly Weinburgh in the College of Education, a pre-post instrument designed to measure attitudes in science is being used as an evaluative tool. Initial development of the second module for the BIOBUS on the senses is targeted for elementary or middle school students, with the assistance of GIFT teacher, David Parlier.

Undergraduate Programs

We have established two programs to attract students to careers in behavioral neuroscience: Center for Behavioral Neuroscience Undergraduate Fellows (CBNuf) Program and Introduction to Science Seminar (ISS). Detailed descriptions of both programs appear on the Center's website, www.cbn-atl.org. These **undergraduate programs** focus on Center students. Although all programs are open to all Center students, a particular focus is on the preparation and recruitment of under-represented students. All participating schools have a high percentage of minority students interested in science. We have:

- Established requirements for Center for Behavioral Neuroscience Undergraduate Fellow
- Developed introductory seminar for freshman and sophomores "Intro to Neurosciences and Behavior", which will feature CBN faculty and will be offered this Fall.
- Developed an initial list of approved internships and lab experiences listed on our website

- Recruited first cohort of Fellows with Summer Undergraduate Research Experience and internships (23 in SURE; 10 in the Morehouse's HBCU-UP program)
- Designed lab courses at Atlanta University Center Schools
- Developed outline for BS/MS

CBN Undergraduate Fellow (CBNuf (www.cbn-atl.org/education/cbnuf/index.htm):

The Center for Behavioral Neuroscience will offer a neuroscience undergraduate fellows distinction to undergraduate students meeting CBN requirements, including coursework and research (see website). The distinction will be similar to an honors designation, and will be placed in the commencement program. The CBN will award a certificate, and maintain records of those awards. The CBN Undergraduate Fellows program will begin in the fall of 2000. We are planning to submit an NSF REU application this fall for CBN students.

Introduction to Science Seminar (ISS)., The CBN has developed a seminar-based program, Introduction to Science Seminar (ISS), to stimulate interest among freshmen and sophomores of the member institutions in doctoral studies. The seminars will be led by faculty from the member institutions and will address ethics, scientific careers, and current findings in behavioral neuroscience. Undergraduate students participating in the program will be given a stipend of five hundred dollars (\$500) AFTER the successful completion of the program. Successful completion of the program entails full participation in ALL seminars, completion of a brief lab rotation with a CBN faculty member, involvement in an exit interview, and submission of a proposal for participation in an additional experience in a science-related internship (e.g. science education, journalism, science policy, etc.).

Summer Research Programs (see appendix 9 for list of students)

The Summer Undergraduate Research Experience (SURE) Program ran from June 5 - August 7, 2000. Participants, mostly rising juniors and seniors enrolled at Emory University and other 4-year colleges, were engaged in research full-time. They also participated in activities designed to help them better understand research ethics and the many career opportunities available to science majors. CBN funds directly supported stipends and housing for 10 participants in SURE. In addition to students supported by the CBN in the SURE program, the HBCU-UP summer program supported 5 minority students working in CBN labs at Morehouse and Georgia State.

Developed outlines for undergraduate major at member institutions

Currently, Emory University is the only member of the CBN with an undergraduate major in Neuroscience and Behavioral Biology. GSU faculty in Psychology and Biology have begun to meet to develop requirements for a major. We are currently working on an outline for neuroscience concentrations/majors at the other member institutions. At Morehouse, the Departments of Biology and Psychology proposed a minor in neuroscience to be added to the College curriculum. This was approved by both the College curriculum committee and the faculty as a whole, and will start in the fall of 2000. Students fulfilling the requirements for the neuroscience minor will be eligible to be Undergraduate Fellows at the Center for Behavioral Neuroscience by participating in a summer program or internship offered by the Center. In addition, students pursuing a neuroscience minor will be given preference for admission to the inter-institutional BS-

MS dual-degree program that will be offered by the Center starting in the fall of 2001. The minor in neuroscience, and the pipeline it offers to the programs of the Center for Behavioral Neuroscience are programs unique among HBCUs, and these programs will be powerful recruiting tools for top-quality students.

Curriculum development at AUC schools

CBN faculty developed several new courses at AUC schools including a new Brain and Behavior course at Morris Brown, a Neurobiology Teaching Laboratory at Morehouse (funded by their HBCU-UP grant), and a new "Mind and Brain: an Introduction to the Nervous System" class that will target freshman and sophomore students, developed by Dr. Pamela Scott-Johnson of Spelman College and Dr. Margaret Weber-Levene of Morehouse. Equipment orders for new lab courses will be placed when all subcontracts are in place.

Developing a BS/MS program

One of the major goals of the CBN is to attract students, particularly women and minorities, to doctoral studies in behavioral neuroscience. The BS/MS program is designed to attract students into graduate programs at the Center and elsewhere, and to allow students with an interest in research an extra year to decide if a research career is right for them. Of the students who enrolled in MS programs in the science between 1996-1999, 67% were women and 13.3% were minorities. Hence, we believe that an MS program that provides seamless transition into a Ph.D. program will be an effective means of increasing the number of minorities and women attaining PhDs in the sciences. The BS/MS (4+1) program will be open only to Center students nominated by faculty advisor in junior year or first semester of senior year. Successful applicants will be required to complete all requirements for the undergraduate major by the fourth year of study, after which the BS will be conferred. Work towards the MS must begin no later than the beginning of the fourth year. During the fourth year, students must take a methods course developed by the cores of the CBN and Advanced Topics in Behavioral Neuroscience developed by the graduate committee and taught by an inter-institutional team of CBN faculty; complete 2-3 lab rotations in CBN laboratories; and submit a thesis prospectus by the end of the fourth year. Conferral of the MS degree after the fifth year of study will be contingent on successful defense of thesis. Currently, the undergraduate committee is identifying extramural funding sources to provide for fifth year stipends for BS/MS students. The BS-MS program should be ready by the fall of 2001.

The Graduate Initiatives Committee

The Graduate Committee has been working on the following projects:

- Developing the CBN Scholars Program
- Developing requirements for students supported by the Center as addenda to existing graduate handbooks
- Developing recruitment materials for graduate students
- Developing Frontiers of Behavioral Neuroscience course for first year graduate and senior undergraduate (taught by Collaboratory and Core faculty)
- Developing Special Topics courses in Behavioral Neuroscience

Description of the CBN Scholar Program:

- 1) There will be two paths for entry into the CBN scholar program:
 - Path #1) Students will be recruited to graduate programs as CBN scholars.
 - a) Such students will receive a minimum two-year stipend. The duration of funding and the level of funding will be determined by the admitting institution.
 - b) A mechanism administered through the admitting institution must guarantee continued funding for fellowship recipients after the end of their fellowship period. This can be from grants or other sources.
 - c) Students receiving a fellowship must do a laboratory rotation or internship outside of the admitting program. The CBN will help facilitate these inter-program projects.
 - Path #2) Resident students can apply to be CBN scholars.
 - a) The graduate committee will accept students if their proposed research project involves a collaborative effort between two CBN member labs.
 - b) Such will be eligible for similar benefits to those of recruited students.
- 2) Requirements of CBN scholars:
 - a) Students must fulfill all of the requirements for a Ph.D. of the admitting program.
 - b) Students must take the “Introduction to the Center for Behavioral Neuroscience” course (preferably in their first fall semester in the program).
 - c) Students must take one “Advanced Topics in Behavioral Neuroscience” course per year while in the first 4 years of training. The Intro to the CBN course may substitute for one Advanced Topics course.
 - d) Students are encouraged to attend the monthly Center for Behavioral Neuroscience Seminar
 - e) Students must have one member of the dissertation committee be a CBN member from another institution or graduate program.
 - f) The student’s Thesis advisor must be a member of the graduate faculty of the CBN.

Two new graduate students, both African American females, have been selected for the program. Both enrolled at GSU. We anticipate that students from other participating graduate programs will enroll this Fall. Matia Banks will be studying the neurobiology of conditioned defeat will work with Dr. Kim Huhman and Michele Foster will be working with Dr. Tim Bartness.

e. Knowledge Transfer

This component includes technological developments for integrating research and education, public education and technology transfer. We have made significant progress on all fronts.

Technology for Integrating Research and Education

Accomplishments this year include:

- LearnLink accounts and training provided for all Center Faculty, GIFT teachers and workshop participants with LearnLink CBN conference structure developed

- Set up CBN website
- Identification of infrastructure needs and initial hardware evaluation for multicast desktop and high-bandwidth video conferencing
- Coordination of resources and personnel to enable telecourses
- Identification of cross-registration procedure via Atlanta Regional Consortium of Higher Education

The next year will be critical for planning infrastructure improvements and enhancing all our activities associated with technology. Our plans include:

- Increasing online faculty participation via LearnLink
- Continuing CBN web and ScienceNet development including:
- Initiating course offerings at multiple locations via teleconferencing
- Utilizing teleconferencing facilities to communicate with NSF and other STCs
- Deploying streaming video and audio for webcasting of center activities and core/collaboratory seminars
- Publishing interactive collaboratory and core tours via website
- Applying for funding for infrastructure development for integrating research and education

Public Education

The center is developing a series of links both internally to the participating institutions and externally to the public via ZOO Atlanta, SciTrek, CNN, and the Carter Center.

Accomplishments to date include work with SciTrek to develop a NIH SEPA proposal for the development of a BioTrek educational exhibit and program. The CBN will be involved in developing the brain and behavior components and workshops for teachers and with the ethics component. We are also assisting them in developing a proposal to HHMI for this fall to further extend this exhibit.

We have also begun to work on a plan for expanding Brain Awareness week into Brain Awareness month. We will be working with the Atlanta Neuroscience chapter to host public education lectures in the schools. Students who have conducted research in CBN labs this summer will present their work to school classrooms.

Morehouse College is hosting the 2000 Animal Behavior Society meeting August 5-9. We plan to host a reception for attendees and have invited faculty and Students of the CBN to attend the meeting. A full schedule for the 2000 Animal Behavior Society meeting at Morehouse College may be found at the ABS web site at:<http://www.animalbehavior.org>

Our plans to hold a conference for scientists and journalists next year have been slowed by the departure of the chair of the journalism program. The new director, Sheila Tefft, is enthusiastic about the concept and is assisting us in identifying science journalism internship opportunities for Center students.

We have been working with the National Computational Science Alliance in several ways. Dr. Marsteller is involved in the Biology Workbench project as an advisor and as a workshop host. The Atlanta University Center is participating as a remote location in the

Alliance Chautauqua 2000 event to be held at the University of Kansas to introduce Alliance technology innovations to national research communities. The Chataqua shows how computing, science portals, and computational and access grids are changing the way people communicate, learn, and conduct research and business. We hope to continue to work with this group to build CBN infrastructure, particularly in the Atlanta University Center schools and to provide college and high school teachers with new technological tools. Next Spring we will host a Biology WorkBench workshop for Biology and Chemistry faculty and we hope to send several of our teachers to the summer program.

Technology Transfer

The Center's unique mechanism for linking discoveries and new technologies to industry via the Biotechnology Development Center (BDC) has been launched but under a new name: EmTech. EmTech will provide the infrastructure necessary for managing the early to middle phases of the commercial development process in order to simultaneously increase the yield of successful ventures and capture a greater share of the potential compensation. EmTech is a collaboration among Emory University, GaTech, the Georgia Research Alliance, local foundations and commercial sector representatives. This comprehensive initiative will provide a novel and cost-effective mechanism for nurturing the development of early stage technology. It will also develop and coordinate all of the components required to translate university-based discoveries into innovative products and services that will boost our local and state economies and provide a revenue stream for Center scientists.

We have begun the process of negotiating a technology transfer agreement that is acceptable to all participating institutions, insuring a revenue stream for the Center. A draft agreement has been discussed with the Internal Advisory Board and is now in the hands of the Emory Office of Technology Transfer.

Plans for year 2

- Create a web form for invention disclosures that will be simultaneously distributed to the relevant university offices that manage technology transfer, as well as to the Center's Executive Committee. The Center's co-director for technology transfer will take the lead in coordinating the management of the Center's technology portfolio with the partnering universities.
- Sponsor a seminar program that focuses on technology transfer issues. Since most of these issues are, in general, not discipline-specific, the program can be done collaboratively with other interested groups from academia, industry and government.

f. Shared Experimental Facilities See description of core resources (c)

g. Administration and Management

Organizational Chart -see appendix 10

Director's Narrative

The CBN has gotten off to a good start with development of an administrative team, completion of an ambitious strategic plan, and early progress in each of the major components. As of July 31, 2000, we are clearly still at the beginning of this effort.

Indeed, the Cooperative Agreement was signed by NSF only 2 months ago and the subcontracts have been signed by only 2 of 7 institutions. So, in a fiscal sense, we are not quite official yet at all the participating institutions. But already I can report some challenges that will need to be addressed in the near future. I will describe these in two categories: administrative/cultural and strategic/scientific.

The administrative challenge of developing a consortium with 8 institutions cannot be overstated. Although these institutions are all located in Atlanta and most have made a specific commitment to neuroscience as a focus of academic development, there is little precedent for collaborative programs. Our Internal Advisory Board which brings the 8 provosts (or their designees) together for regular meetings is the first such effort to bridge these schools around a scientific program. But with or without the provosts, there are substantial problems to collaboration. Some of the obvious major impediments to sharing students and courses have already been resolved by aligning schedules and permitting cross-registration across the institutions. Other problems, which might seem minor impediments, such as transportation and parking, remain surprisingly refractory. We expect to overcome these barriers by networking between the schools, permitting virtual conferences. A more difficult and thorny issue is the difference in culture between the schools. The Atlanta University Center is made up of 5 institutions that are dramatically different in character and mission. Even within Emory University, we have been faced with cultural differences between the College and the Health Sciences Center. Faculty across institutions share many common interests, but there are different priorities for department chairs and administrators. As the CBN launches recruitment efforts, sets graduate student stipends, and develops inter-institutional intellectual property guidelines, these cultural differences between and within institutions have posed a major challenge. To facilitate relationships between the schools we have added a Steering Committee to our Organizational Plan. This group meets every Monday morning to plan out Center activities each week. The Steering Committee, chaired by the Director, includes the co-directors, deputy directors, and a representative from the AUC (Dr. Pam Scott-Johnson of Spelman College).

The second category of concerns is within the scientific thrust. As an aside, the educational programs have gotten off to a promising start, partly because they could build on several existing efforts (S.U.R.E. and G.I.F.T., for instance). But within the scientific component, we had neither a strong foundation of collaboration nor a well-developed program of research at every institution. Not surprisingly, we are struggling with the concept of "collaboratory". In spite of discussion groups and workshops and retreats, collaboratories still need to coalesce. No question that collaborations have developed and that some of these involve entirely innovative and interdisciplinary approaches to the neurobiology of social behavior. But the vision of a cross-institution, cross-discipline research "group" still needs to be realized. This may be an experiment which will yield mixed results: providing some new scientific approaches but not a new model for doing science. At this point, we are still collecting the data, using students, post-docs, and venture grants to foster collaborations and encouraging our collaboratory leadership to organize synergy within their areas. And we are still refining our scientific focus, with the neurobiology of social behavior as a basic theme on which there are many variations. These issues will be addressed at our first External Advisory Board meeting on September 7-8, 2000.

A related issue is the integration of collaboratory and core programs. Many of our scientific faculty have yet to recognize the potential of these cores. Although the microarray facility has generated considerable interest, I have been surprised by the relative absence of interest in protein arrays, imaging, and multi-channel recording. With increasing education and sophistication of the faculty and increasing visibility of these cores, more of our investigators will no doubt begin to use these powerful technologies. We also need to recruit strong scientists to raise the quality of research within the program as a whole. Thus far, we have recruited 3 new investigators (1 at Georgia State and 2 at Emory) and we have submitted an offer for an endowed professor neurophysiologist. Additional recruitments are underway at Emory, Georgia State, Morehouse College, and Morehouse Medical School. We continue to work with the respective departments to ensure that these are indeed joint recruitments.

Finally, a core value of this Center is the integration of research and education. My concerns in this first year have been mostly on the research side because we need a stronger scientific program to attract and educate the best students. Ultimately, success for our Center means including both undergraduate and graduate students from its various schools into its scientific programs and involving our best investigators with students at multiple levels. I am hopeful this will evolve, but at the outset, we need to clarify this aspect of the vision for all participants.

Advisors:

INTERNAL ADVISORY BOARD

Dr. Sylvia Bozeman
Associate Provost
Spelman College

Dr. Ron Henry
Provost
Georgia State University

Dr. Rebecca Chopp
Provost
Emory University

Dr. Peter MacLeish
Director, Neuroscience Institute
Morehouse School of Medicine

Dr. Isabella Finklestein
Chair, Department of Biological
Sciences
Clark-Atlanta University

Dr. Mike Thomas
Provost
Georgia Institute of Technology

Dr. J.K. Haynes
Dean, Sciences; Chair, Dept Biology
Morehouse College

Dr. Grant Venerable
Interim Provost and Dean of Faculty
Morris Brown College

CBN EXTERNAL ADVISORY BOARD

Dr. Gene Block, Chair
Dept. of Biology
University of Virginia

Dr. Shirley Malcom
Dir. Education and
Human Resources
AAAS

Dr. Klaus Miczek
Tufts University
Dr. Kathie Olsen
Chief Scientist, NASA
Headquarters

Dr. Dorothy Cheney
Dept. of Biology
Univ of Pennsylvania

Dr. Peter Marler
Animal Comm.,
Department of Zoology
U of California Davis

Dr. Tony Shuker
Dir. Industrial
Relations/Tech. Transfer
Georgia Institute of
Technology

Dr. Errol B. De Souza
Aventis
Pharmaceuticals Inc.
Bridgewater, New
Jersey

Dr. Eve Marder
Volen Center
Brandeis University

Dr. Phil Skolnick
Lilly Corporate Center
Neuroscience Research

Dr. Edward Kravitz
Dept. of Neurobiology
Harvard Medical
School

Dr. Bruce McEwen
Dir. Laboratory of
Neuroendocrinology
The Rockefeller
University

Dr. Sanya A. Springfield
The Comprehensive
Minority
Biomedical Branch, NIH

i. Appendices

Appendix 1 - STC-supported publications and patents (partial STC support)

Jasnow, AM, Huhman KL, Bartness, TJ, Demas, GE, Short-day increases in aggression are inversely related to circulating testosterone concentrations in male Siberian hamsters (*Phodopus sungorus*). Hormones and Behavior, in press

Ferguson J.,N., Young, L.J., Hearn, E.F., Matzuk, M.M., Insel, T.R., Winslow, J.T.: Social amnesia in mice lacking the oxytocin gene. Nature Genetics 25:284-288, 2000.

Winslow, J.T , Hearn, E.F., Ferguson, J., Young, L.J., , Matzuk, M.M., Insel, T.R., Infant vocalization, adult aggression, and fear behavior of an oxytocin null mutant mouse. Hormones and Behavior, in press.

Larry J. Young, Oxytocin and Vasopressin as Candidate Genes for Psychiatric Disorders: Lessons from Animal Models. Neuropsychiatric Genetics. In Press.

Larry J. Young, Z. Wang, T.T. Cooper, H. Elliot Albers, Vasopressin (V1a) receptor binding, mRNA expression, and transcriptional regulation by androgen in the Syrian hamster brain. J. Neuroendocrinology *In Press*

Larry Young, Brenden Gingrich and Thomas R. Insel, Molecular and neuroendocrine mechanisms of affiliation and monogamy. Hormones and Behavior. In press

Appendix 2 - M.S. and Ph.D. students who graduated this year with STC support.

None

Appendix 3 - List of Center Participants Receiving CBN Support

Elliott Albers	Georgia State Univ.	Department of Biology/Psychology
Timothy Bartness	Georgia State Univ.	Department of Psychology
Andrew Clancy	Georgia State Univ.	Department of Biology
Ioannis Constantinidis	Emory University	Department of Radiology
Michael Davis	Emory University	Department of Psychiatry
Steve DeWeerth	GA Inst. of Tech.	Neuroengineering
David Edwards	Emory University	Department of Psychology
Keith Easterling	Emory College	Neuroscience & Behavioral Biology
Gary Falcon	Emory Univ.	CBN
Lorin Freedman	Emory University	Department of Neurology
Kim Gernert	Emory Univ.	BIMCORE
Danielle Gray	Emory Univ.	CBN
Melissa Harrington	Morehouse College	Department of Biology
Scott Hemby	Emory University	Department of Pharmacology
Kim Huhman	Georgia State Univ.	Department of Biology
Thomas Insel	Emory University	Department of Psychiatry
Paul Katz	Georgia State Univ.	Department of Biology
Sean Kimbro	Clark Atlanta Univ.	Department of Biological Sciences
Stuart Leff	Emory University	Department of Neurology
Paul Lennard	Emory College	Department of Biology/NBB Director
Dennis Liotta	Emory College	Department of Chemistry
Peter MacLeish	Morehouse Med.	Department of Anatomy/Neuroscience
Paul Plotsky	Emory University	Department of Psychiatry
Holly Soares	Morehouse Med.	Dept. of Anatomy/Neuroscience
Kim Wallen	Emory College	Department of Psychology
William Walthall	Georgia State Univ.	Department of Biology
Patricia Whitten	Emory College	Department of Anthropology
Mark Wilson	Emory University	Yerkes Regional Primate Center
James Winslow	Emory University	Department of Psychiatry
Larry Young	Emory University	Department of Psychiatry

Appendix 4 - Biographical information for new investigators (see attached)

Appendix 5 - Awards and Honors

Charles Derby - College of Arts & Sciences Outstanding Faculty Achievement Award

Thomas Insel - named to Editorial Board of J. Neuroendocrinology

Michael Kuhar - President Elect - Conference Problems of Drug Dependence

Chris Muly - NARSAD Young Investigator Award, APA/SmithKline Beecham Young Faculty Award for Research Development in Biological Psychiatry

Don Rainnie - NARSAD Young Investigator Award

Barbara Rothbaum - elected to International Society for Traumatic Stress Studies (ISTSS) Board of Directors, November, 2000-2003.

Posttraumatic Stress Disorder Advisory Board for Pfizer Pharmaceutical

Associate Editor, Journal of Traumatic Stress, 2000 present

Kim Wallen - President-Elect - Society for Behavioral Neuroendocrinology

Barbara E. Musolf, graduate student with Don Edwards received Best Student Poster Award in the Invertebrate Zoology Division at the annual meeting of the Society for Integrative and Comparative Biology Jan 4-8, Atlanta for her poster "Regulation of 5-hydroxytryptamine uptake in crayfish."

Appendix 6 - Minutes of Advisory Board Meetings

Minutes of Internal Advisory Board Meeting

1/13/00

Yerkes Reading Room

Attendance:

Provost Rebecca Chopp (Emory), Provost Mike Thomas (GaTech), Provost Ron Henry (GSU), Prof. Peter MacLeish (Morehouse School of Med), Int. Provost Grant Venerable (Morris Brown), Prof. Isabella Finkelstein (Clark Atlanta), Prof. Duane Johnson (Morehouse Coll), Prof. Sylvia Bozeman (Spelman)

CBN: Insel, Marsteller, Albers, Doris Nixon (financial officer)

Absent: Dennis Liotta

The first meeting of the IAB began with introductions. Dr. Insel reviewed the history and mission of the CBN, noting that this is both an inter-disciplinary and an inter-institute project as specified in the NSF Science and Technology Center guidelines. The Center has 3 major objectives: research, education, and knowledge transfer. The research objective is to make discoveries relevant to behavioral neuroscience - including the development of new tools for studying the interaction of brain and behavior. The education objective focuses on increasing the number of minorities, especially African-Americans in neuroscience, using a pipeline approach. The knowledge transfer program will address public understanding of neuroscience and ultimately seek to commercialize discoveries and resources developed by the Center faculty.

The Center is guided by an executive committee with representatives from each of the participating institutions and is assisted by two advisory boards. The External Advisory Board provides guidance by experts on the scientific and educational missions. The Internal Advisory Board serves to (a) promote collaborations between the participating institutions, (b) advocate for the Center at each institution, and (c) resolve issues of equity between institutions. The Internal Advisory Board is composed of the provost or president from each institution or his or her designee.

Dr. Insel presented an overview of the budget. Science and Technology Centers are funded by a cooperative agreement mechanism. Cooperative agreements, unlike traditional research grants, require that the awardee achieve specific milestones prior to release of NSF funds. These milestones are currently being developed as part of a required strategic plan. Emory is the lead institution; funds are distributed to the other participants via subcontracts. NSF intends to fund this Center for ten years, beginning with a 5 year award. There will be annual site visits and a review at year 4 to determine the level of support for the second five year period. In addition to the NSF cooperative agreement, the Center is supported by commitments from the Georgia Research Alliance, the Howard Hughes Medical Institute, and the participating institutions.

In the discussion, Dr. MacLeish emphasized that each institution needs to re-review specific budgets. Provost Henry noted that Georgia State currently enrolls 6200 African-

American students, more than any other school in Georgia. Provost Venerable described the differences between the African American students enrolled at Morris Brown (most of whom are first generation college students) and those enrolled at other institutions in the AUC.

The Committee agreed to meet again in 2 months to review the Strategic Plan. Subsequent meetings will be quarterly or less often depending on the need. Budgets will be distributed as requested.

Minutes of Internal Advisory Board Meeting

4/12/00

Yerkes Auditorium

Present: J.K. Haynes (Morehouse), Ron Henry (Ga State), Isabella Finkelstein (Clark Atlanta), Sylvia Bozeman (Spelman), Elliott Albers (CBN), Dennis Liotta (CBN), Pat Marsteller (CBN), Tom Insel (CBN)

Absent: Rebecca Chopp (Emory), Mike Thomas (GaTech), Peter MacLeish (Morehouse Med), Grant Venerable (Morris Brown)

Following introductions, Dr. Insel described recent progress at the Center, including recent recruitment efforts and completion of a Strategic Plan (attached). The charge to the Committee (communication between participant institutions) was reviewed.

Dr. Liotta reviewed the intellectual property issues likely to be faced by technology transfer efforts in a multi-institutional center like the CBN. Both the scientific and educational programs of the Center are likely to yield products that may be licensed and developed commercially. Dr. Liotta provided a draft intellectual property agreement.(attached) He recommended that (a) each participating institution have its own intellectual property agreement and (b) that some agreement be developed to provide a distribution formula that includes the CBN as a beneficiary. Jones and Askew, a local law firm with expertise in developing intellectual property agreements, has offered its services to each of the participating institutions in the CBN. Dr. Liotta offered to meet with the appropriate official as well as interested faculty at each institution to discuss the importance of intellectual property.

Dr. Marsteller reviewed recent progress within the educational program, including a potential partnership with SciTrek to develop an interactive exhibit on the brain. She has also discussed opportunities for technology development with the National Computational Science Alliance (NCSA), the NSF funded effort to support a national computing infrastructure for the next wave of scientific discovery. NCSA in partnership with the National Partnership for Advanced Computing Infrastructure have been funded to develop technology infrastructure at minority-serving institutions. Central to this project is the development of a technology Grid which will link institutions and ultimately provide resources for Internet II (see <http://www.internet2.edu/>) Dr. Marsteller

will invite Allison Clark to our next meeting to discuss how the CBN can make use of the Grid and, specifically, opportunities for linking all of the CBN institutions to InternetII.

A final discussion item was recruitment at each institution. The CBN has funds from both NSF and GRA to assist with recruitment of scientific faculty. Already the CBN has met with a recruitment challenge: how to align its goals of scientific discovery with departmental needs, both in terms of scientific interest and teaching demands. Dr. Haynes explained the importance of this issue in the biology department at Morehouse College. The committee recommended a series of meetings of CBN and institutional officials (provosts and department chairs) to discuss the specific needs in each case.

The next meeting tentatively scheduled for June 15, noon, at Yerkes.

Appendix 7 - Venture Grants - funded 6/00

Title: Fasting/Food Restriction-Induced Maternal Infanticide: Changes in Prolactin Receptor Gene Expression and Reversal by Leptin

P.I.: Timothy Bartness, Ph.D.; Georgia State University

Collaborators: Larry Young, Ph.D.; Emory University

Abstract:

Infanticide is a disruption in maternal care that is triggered by negative energy balance. Prolactin receptor (PRL-R) activation is required for maternal behavior, and a several-fold increase in brain prolactin receptor gene expression coincides with the onset of maternal behavior. The goals of this application are to determine whether the disruption of maternal behavior by negative energy balance is associated with a dysregulation of the PRL-R gene expression— perhaps caused by decreased leptin, a fat-derived peptide secreted in proportion to adiposity. The efforts of two laboratories, institutions, and fields are combined to study mechanisms underlying behavior relevant to the CBN theme/mission.

Title: Activation of Steroid Sensitive Neurons by Mating in α ERKO Mice

P.I.: Andrew Clancy, Ph.D.; Georgia State University

Collaborators: Sean Kimbo; Clark Atlanta University

Abstract:

Estrogen and androgen are important for mating by males of several species, including rodents. Specific estrogen receptor (ER) containing neurons that contribute to mating were identified in the male rat medial preoptic area and medial amygdala. However, at least 2 different forms of ER were discovered, ER_{tt} and ER_p, and it is not known whether neurons containing only 1 of these or both of them influence mating. Mating is compromised in male mice α -y ER(x) knockout ((x)ERKO), suggesting ER(x) is important for copulation. We will identify specific populations of ER_a-containing neurons important for mating and the behavioral role of ER.

Title: Long Term Reversible Brain Inactivation: A Novel Technique for Behavioral Neuroscience

P.I.: Lorin Freedman, Ph.D.; Emory University

Collaborators: Kim Wallen, Ph.D.; Emory University
Mark Wilson, Ph.D.; Emory University

Michael Mustari, Ph.D.; Emory University

Abstract:

Our goal is to develop a self-contained system capable of producing long-term and precise reversible activation or inactivation of specific brain regions. This system will consist of chronic indwelling MRI-compatible brain cannulae attached to an indwelling or body-worn pumping system to allow long term administration of various pharmacological agents. These techniques will then be validated using neuroendocrine and oculomotor endpoints. Development of this system opens a wide range of studies in a variety of different species investigating the activity of specific brain regions on sexual and aggressive behavior, fear and affiliation.

Title: Understanding the Neural Correlates of Prey Tracking in a Carnivorous Snail

P.I.: Melissa Harrington, Ph.D.; Morehouse College

Collaborators: Peter MacLeish, Ph.D.; Morehouse School of Medicine
Anthony Cole; Morehouse College

Abstract:

Euglandina rosea, a carnivorous snail, obtains its prey by following slime trails. *Euglandina* follow >90% of slime trails encountered even when right angle turns are required. Following heterospecific trails ends in predation, while following conspecific trails leads to mating. Individual *Euglandina* do not follow their own trails. Chemosensory stimuli from slime trails result in two types of behavioral outputs: 1) a change in direction of motion; and 2) a choice between an aggressive versus an agonistic interaction (predation versus mating). We propose to search for neural correlates of this behavior by identifying the neural systems involved, characterizing the neural signals representing slime trail information, and studying how these signals influence behavior.

Title: Neurobiology of Conditioned Defeat

P.I.: Kim Huhman, Ph.D.; Georgia State University

Collaborators: Michael Davis, Ph.D.; Emory University

Abstract:

Molecular techniques have become extraordinarily useful tools in many areas of neuroscience, yet these techniques have only begun to be employed for the study of complex social and emotional behavior. This project will use viral vector-mediated gene transfer to overexpress the transcription factor, cAMP response element binding protein (CREB), in the amygdala of hamsters exposed to social defeat. This manipulation has

been shown to increase fear conditioning in relatively simple paradigms, and we hypothesize that it will facilitate the acquisition of conditioned defeat, as well. These studies will advance our understanding of fear conditioning in more naturalistic situations and will begin to define the neural circuitry mediating behavioral responses to social conflict.

Title: Development of Small Molecules for Oxytocin and Vasopressin Receptors

P.I.: Thomas Insel, Ph.D.; Emory University

Collaborators: Elliott Albers, Ph.D., Ga State
Dennis Liotta, Ph.D., Emory College

Abstract:

Oxytocin and vasopressin have been implicated in the neurobiology of social behavior in rodents, yet we know very little about the importance of these neuropeptide systems in human social behavior. The absence of selective ligands that cross the blood-brain barrier has precluded clinical studies. Using molecular modeling with Dr. Jim Snyder in the Emory University Dept of Chemistry, we have identified 20 candidate small molecules. The goal of this project is to test these with in vitro binding prior to in vivo behavioral and imaging studies.

Title: A Behavioral Neuroscience Teaching & Learning Center: A CBN “Quasi Mini Core”

P.I.: Paul Lennard, Ph.D.; Emory University

Collaborators: Marijin Brummer, Ph.D.; Emory University
Keith Easterling, Ph.D.; Emory University
Melissa Harrington, Ph.D.; Morehouse College
Lori Marino, Ph.D.; Emory University

Abstract:

Integration of research and education stands as one of the primary goals of the CBN education plan. We propose the development of a Behavioral Neuroscience Teaching & Learning Center (BN-TLC) with the mission of facilitating the transfer of CBN research into effective teaching materials deliverable to students at all of the CBN institutions. The BN-TLC would provide a platform-independent hardware/software development environment. As proof of concept, we propose to implement two very different projects, a brain imaging module and a behavioral neuroscience database. An administrative structure to coordinate activities across institutions is incorporated into the design of the

BN-TLC.

Title: Determination of the Temporal Cascade of CNS Gene Expression Underlying Individual in Response to Neonatal Maternal Separation

P.I.: Paul Plotsky, Ph.D.; Emory University

Collaborators: Larry Young, Ph.D.; Emory University

Abstract:

Individual variation in behavior is the result of complex interactions between the environment and the genome. We have developed a model that produces stable alterations in behavior, responsiveness to stressors, and brain neurochemistry by manipulating post-natal experience. Short separations of rat pups from the mother result in elevated grooming from the mother, while longer separations disrupt normal maternal care. Pups from these two conditions display different patterns of behavior as adults. We propose to use DNA microarray technology to determine the effect of these rearing conditions on the temporal cascade of neonatal gene expression in specific regions of the brain.

Title: Characterizing the Role of a Nuclear Hormone Receptor Involved in Male Mating Behavior of *Caenorhabditis elegans*

P.I.: William Walthall, Ph.D.; Georgia State University

Collaborators: Kim Gernert, Ph.D.; Emory University
Holly Soares, Ph.D.; Morehouse School of Medicine

Abstract:

This project has two goals. First, to use protein modeling software to predict the structure of the ligand binding domain of a nuclear hormone receptor that is necessary for a critical step in male mating behavior in *C. elegans*. Databases will then be searched for potential ligands. This information will aid in the design of biochemical assays to identify the natural ligand. Second, to understand the receptor's function, we will use molecular approaches (e.g. subtraction hybridization and/or differential display) to identify downstream target genes. Our objective is to use interdisciplinary approaches to determine this receptor's role in male mating behavior.

Title: Neural Mechanisms of Phytoestrogen Action on Reproductive Behavior

P.I.: Patricia Whitten, Ph.D.; Emory University

Collaborators: Larry Young, Ph.D.; Emory University

Abstract:

Phytoestrogens are estrogenic plant products that interact with the endocrine system and may modulate animal reproductive function. Previous research has shown that isoflavones, a class of phytoestrogens found in legumes and soy-based foods, are weak estrogen agonists/antagonists. Although the isoflavones, have been associated with a myriad of health benefits in humans, their effects on the brain and behavior are completely unknown. The goal of this project is to determine whether the isoflavone genistein can cross the blood-brain barrier and alter estrogen-dependent gene expression and behavior using a rodent model. The project consists of two specific aims:

- How does dietary ingestion of genistein alter estrogen-dependent reproductive behaviors in the female rat?
- What are the molecular mechanisms by which genistein affects reproductive and estrogen-dependent gene expression?

Title: Development and Validation of Conditioned Fear Protocol in Monkey

P.I.: James Winslow, Ph.D.; Emory University

Collaborators: Michael Davis, Ph.D.; Emory University

Abstract:

The goal of this project is to develop an apparatus to measure the acoustic startle reflex in rhesus monkeys and to determine experimental procedures to measure habituation, prepulse inhibition and fear potentiated startle in this species. In rodents, the startle reflex has proven to be an excellent behavioral test system to delineate brain systems involved in these types of behavioral plasticity. In humans, the startle reflex also has proven to be a sensitive measure of these types of plasticity that often differ in certain groups of psychiatric patients. By combining the neural systems approach in rodents with measurement of specific changes in startle or startle plasticity in humans, inferences are made as to the underlying neural sites of pathology. However, given the limitation of extrapolating directly from rodents to humans it will be important to analyze brain systems involved in startle plasticity in higher species, especially non-human primates. The data generated from these studies will be used to support applications for further support from NIMH for the study of brain systems involved in startle plasticity as well as normal and pathological emotional development in non-human primates.

Appendix 8 : Teacher Programs Summer 2000**GIFT teachers in CBN labs**

Malaika Jordan BT Washington High School	Dr. Keith Easterling, Emory
Rhonda Montgomery-Stroud Clarkston High	Dr. Kim Huhman, GSU
Glenda Thomas Henry County High	Dr. Paul Katz, GSU
Melanie Shannon Stickbridge High	Dr. Charles Derby, GSU
Jormell Bland, BTWHS	Dr. Kim Gernert , Emory
David Parlier Sutton Middle School	Dr. Melissa Demetrikopoulis at GSU
Shaundra Mattox , BTWHS	Dr. Kim Gernert , Emory

Teacher Workshops**Brain Adaptation Workshop (Supported by CBN)**

Stephanie Payne	Nikki Mouton
Tina Strong	Shirley Shivers
Arica Johnson	Jacquelyne Fudge
Sharlonne Rollins	Corey Davidson
Tiffany Davidson	Britt Cottingham
Millicent McCaskill	Mary Smith
Jennifer Belcher	Ayana Jackson
Barbara Winfrey-McDaniel	Dean Potts
Tameka Goodson	Johnnie Reid
<u>Robin Lawson</u>	

Interactive Case Based Learning (Cost-share through HHMI)

Shirelene Gray-Carter	Steven Walton
Dorothy Kirkpatrick	Auis Colston
Gussie Phillips	Carl Zeigler
Alma James	Tina Strong
Sharlonne Rollin	Warren Goetzel
Tiffany Davidson	Nichol Shelton
Will Todd	Angela Christian-Vaughn
Malaika Jordan	Shaundra Mattox
Jormell Bland	Termerion McCrary
Carl Fouch	Oscar Boglin

The Molecular Modeling Workshop (Cost-share through HHMI)

Tina Strong	Sallie Sanders
Monique Hunt	Will Todd
Mensam Okyere	Danielle Doucette
Redick Brown III	Sharlonne Rollin
Tiffany Davidson	LaTrelle McFarlane
Craig Ogden	Melody McCall
Pamela Alexander	

Appendix 9 : Summer Undergraduate Students (SURE 2000)

Funding Source	Gender	Ethnicity	LastName	First	Middle	School	Mentor and Department
CBN	Female	African-American	Canton	Ria	T.	Spelman College	Psychology Dr. Robin Morris
CBN	Female	Caucasian	Carpenter	Kelli	R.	Transylvania University	Psychiatry Dr. Larry Young
CBN	Female	Asian-American	Chang	April	B.	Wellesley College	Neuroscience/Yerkes Dr. Mike Kuhar
CBN	Male	African-American	Dewsbury	Bryan	M.	Morehouse College	Biology Drs. Chris Beck and Larry Blumer
CBN	Female	African-American	Edwards	Veronica	W.	North Carolina Central Univ	Chemistry Dr. Dennis Liotta
CBN	Female	Caucasian	Gordon	Emily	B.	Emory University	Chemistry Dr. Dennis Liotta
CBN	Male	African-American	Humphries	William		Morehouse College	Neurology Dr. Allan Levey
CBN	Female	Caucasian	Phinney	Erin	M.	Emory University	Psychology Dr. Frans deWaal
CBN	Male	Caucasian	Shulman	Marc		Emory University	Psychiatry Dr. Paul Plotsky
CBN	Female	Caucasian	Tropp	Aviva		Columbia University	Psychology Dr. Frans deWaal