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Manganese-Enhanced MRI Used to Identify Aggression Circuits

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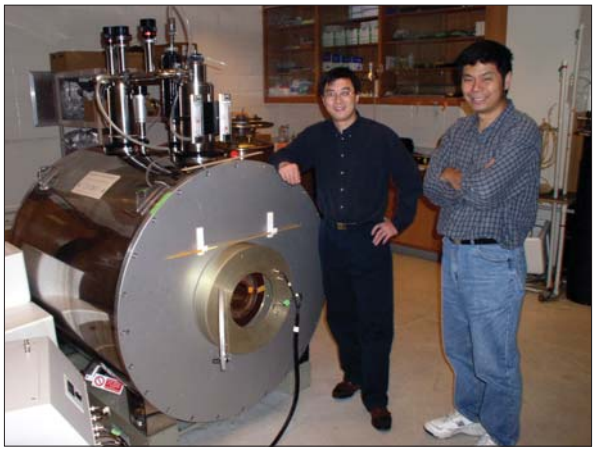
subordination and the intention to escape.

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

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

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



Xiaoping Hu (left) and CBN post-doc Xiaodong Zhang have adapted the small animal MRI scanner at the Emory School of Medicine to image the crayfish brain. Currently, they are working to enhance the resolution of the scanner and develop a customized coil for the crayfish head.

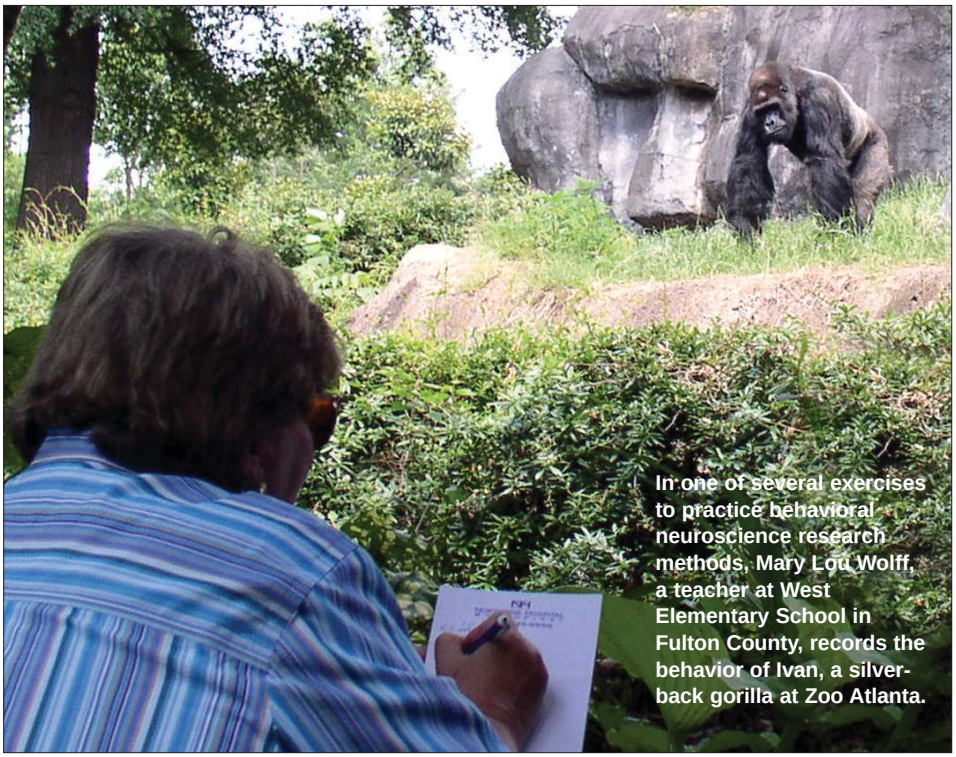
Manganese can be rapidly infused into the crayfish brain and is well tolerated. For these reasons, Hu projected it will be possible to conduct longitudinal studies of individual crayfish using MRI technology to assess changes that occur in its brain over an extended period.

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

CBN Synapse
Editor: Poul E. Olson
A publication of the Center for Behavioral Neuroscience, (404) 463-9433

CBN Synapse

A quarterly publication of the Center for Behavioral Neuroscience | Vol. 4, No. 2 | Spring 2003



In one of several exercises to practice behavioral neuroscience research methods, Mary Lou Wolff, a teacher at West Elementary School in Fulton County, records the behavior of Ivan, a silverback gorilla at Zoo Atlanta.

Teachers Explore Animal Behavior at Zoo Atlanta

In support of K-12 professional development in metro Atlanta public schools, the CBN Education Program co-sponsored a behavioral neuroscience workshop for 17 teachers June 9-13 at Zoo Atlanta. The workshop, titled "Why They Do What They Do at the Zoo: Animal Behavior and the Brain," featured an overview of behavioral neuroscience, talks on specific animal behaviors seen at the zoo, and behind-the-scenes tours. Laura Carruth, Ph.D., assistant professor of biology at Georgia State University, led the program with several CBN graduate students.

A New View of the Crayfish Brain

CBN researchers develop MRI technique for identifying neural pathways

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

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

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

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

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

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

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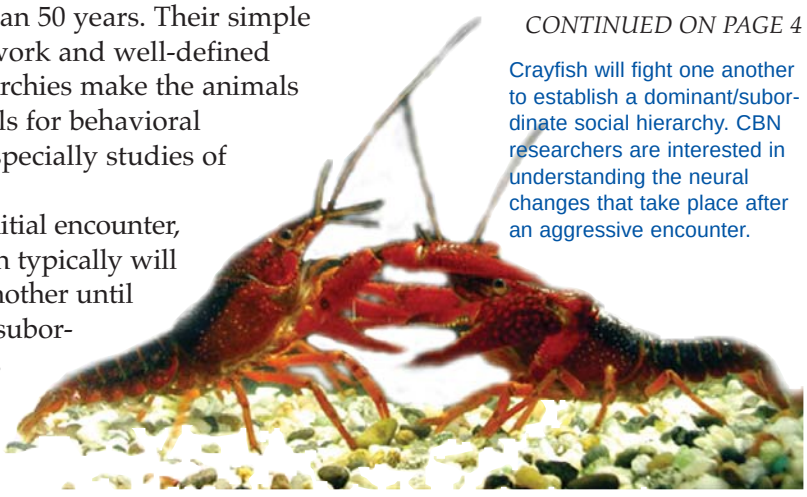


Crayfish will fight one another to establish a dominant/subordinate social hierarchy. CBN researchers are interested in understanding the neural changes that take place after an aggressive encounter.

Site Team Endorses Five Additional Years of NSF Funding

Elliott Albers

After three days of presentations and intensive discussions, 14 National Science Foundation (NSF) officials and scientists "unanimously and enthusiastically" endorsed continued support for the CBN through November 2009. Although there are several steps that must occur before October when the NSF makes a final determination of our $17.3-million grant renewal application, we should all be pleased with its initial evaluation of our accomplishments and goals.

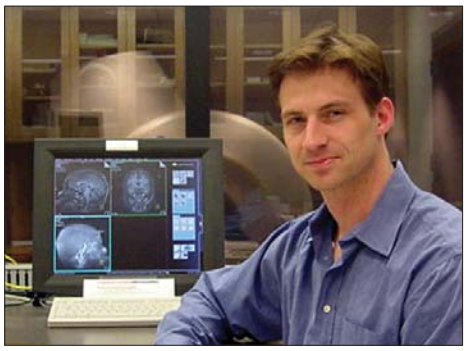
The site visit, which took place May 14-16 at Georgia State University (GSU), involved the participation of some 50 CBN undergraduates, graduate students, post-docs, and faculty. After opening comments from GSU President Carl Patton, Emory President Bill Chace, and Morehouse President Walter Massey, representative faculty from each collaboratory and core showcased the research programs and services provided by their respective groups. The site visitors also learned about the Center's array of educational programs and its efforts to bring behavioral neuroscience to the public through its community partners, such as Zoo Atlanta and SciTrek. Other highlights included a luncheon with CBN students, a tour of CBN laboratories at Spelman College, and a question-and-answer session with GSU Provost Ron Henry.

We and the site visitors were excited to hear from Mike Cassidy, president of the Georgia Research Alliance (GRA), who affirmed the GRA's commitment of an additional $8.5 million in infrastructure support—$1 million more than it has provided for the CBN's first five years—should the NSF grant renewal officially materialize.

The overwhelming success of the site visit resulted from the energy and commitment of many members of the Center, especially Associate Director Kelly Powell for her tireless e-mail communiqués in preparation for the visit. I also would like to thank Patricia Bryan, Cynthia Forrest, and John Medlock of the GSU College of Arts and Sciences Dean's Office who helped with the logistics of the site visit.

The site team's report can be downloaded at http://www.cbn-atl.org/sitereport.pdf.

—Elliott Albers, CBN director

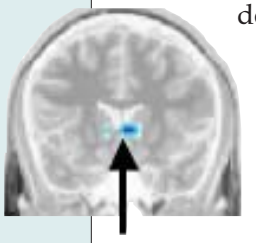


Jim Rilling

Anthropologist to Join CBN

Functional Magnetic Resolution Imaging (fMRI) and Positron Emission Tomography (PET) are among the most powerful tools for puzzling out the neural bases of social behavior. In September, anthropologist James Rilling, Ph.D., who has extensive experience with these neuroimaging methods, will join the CBN.

Rilling, who is currently a post-doctoral fellow at Princeton University's Center for the Study of Brain, Mind, and Behavior, has used fMRI to compare differences in the brain activity of people who play socially interactive games. He also has studied differences in brain proportions between humans and primates to understand the neural bases of cognitive specializations and brain evolution.



Jim Rilling has found increased activation in areas of the brain that form part of the dopamine reward system during social games in which players choose to cooperate with each other.

At the CBN, he plans to continue his research of the neural bases of human social behavior using fMRI.

Rilling earned his doctorate in anthropology from Emory where he also completed a post-doc in neuroimaging in the Department of Psychiatry and Behavioral Sciences.

Early-Life Environments Shape Stress Behaviors and Learning Ability

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

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

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

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

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

CBN Sponsors Eight GIFT Teachers

Eight teachers from metro Atlanta public schools began an eight-week summer research experience in CBN labs as participants in the Georgia Industrial Fellowships for Teachers (GIFT) program. The professional development program is designed to foster science and mathematics teaching based on inquiry, problem solving, and "real world" applications. In addition to research mentors, the CBN is providing co-mentors to guide the teachers in the development of research-based curriculum materials to take back to their classrooms.■

CBN GIFT fellows for summer 2003 are (back row, left to right) Oscar Boglin, Anne Granville, and Alfred Porter. Front row, from left to right, are research mentor David Walker and GIFT Fellows Kemberlee Pugh-Bingham, Sallie Barrett, and Shawnda St. Louis. Not pictured are Davida Carr and Glenda Thomas.

Collaboratory Meetings: June-August

Thursday, June 19, 9-11 a.m.
Fear Collaboratory
Tuesday, June 24, 3:30-5:30 p.m.
Aggression Collaboratory

Tuesday, July 8, 3:30-5:30 p.m.
Affiliation Collaboratory
Wednesday, July 9, 4–5:30 p.m.
Reproduction Collaboratory
Thursday, July 17, 9-11 a.m.
Fear Collaboratory
Tuesday, July 22, 3:30-5:30 p.m.
Aggression Collaboratory

Tuesday, Aug. 12, 3:30-5:30 p.m.
Affiliation Collaboratory
Tuesday, Aug. 26, 3:30-5:30 p.m.
Aggression Collaboratory
Wednesday, Aug. 27, 4-5:30 p.m.
Reproduction Collaboratory

Locations: Affiliation and Fear—Yerkes 1st floor conference room and GSU Kell Hall room 212; Reproduction—Emory Psychology Bldg. Room 201 and GSU Kell Hall room 212; Aggression—GSU Kell Hall room 212 (not videoconferenced).