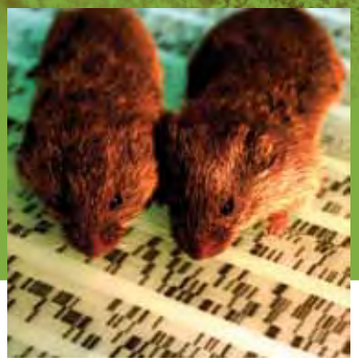
CENTER FOR BEHAVIORAL NEUROSCIENCE CBN

UNDERSTANDING THE ROLES OF NATURE AND NURTURE IN ANIMAL BEHAVIOR

Mating. Aggression. Fear. Researchers at the Center for Behavioral Neuroscience (CBN) are trying to understand the basic neurobiology in animals involved in emotional responses such as these.



Above: Voles. Much of the work on social bonding behavior, or "affiliation," comes from studies of these animals.

Work in the center has helped to shed light on the roles of both nature and nurture in animal behavior. One important outcome is the understanding that hormones like vasopressin and oxytocin play important roles in the forming of social bonds and more generally, in the processing of social information.

Although researchers are still a long way from applying very many of the results to human beings, the hope is that this work "will be the underpinning for new drugs for things like autism and depression," among other conditions, says center director Elliott Albers, Regents professor at Georgia State University (GSU), the headquarters for CBN. In addition to GSU, the partnership has included Clark Atlanta University and Emory University, Georgia Institute of Technology, Morehouse College, Morehouse School of Medicine, and Spelman College.

Much of the work on social bonding behavior, or "affiliation," comes from studies of hamster-sized rodents called voles. They provide a good model for affiliation studies, explains Larry Young of Emory University, because one species of vole is very highly social and takes a life-long mate, while another species is not monogamous. "So, we can do comparative studies," says Young. "They look the same, but the behavior is very different, and we can look in the brain and find things that are different between the two species that might explain that difference in social behavior. The voles give us an opportunity to understand what that neurochemistry might be."

The researchers have found that genes for vasopressin (AVP) and oxytocin (OT) regulate social recognition. These hormones act on the brain's reward circuitry to regulate the formation of social attachments between animals. Amazingly, transferring a receptor gene for AVP into the brain increases social or pair-bonding behavior in male monogamous species of vole, and it makes the "promiscuous" male meadow voles monogamous.

Young, who has led the research group at CBN focusing on affiliation, notes that "this research, which was started in the center and has been going on for the past eight years, has really important broader implications for the study of autism, antisocial behavior, and social communication and bonding. It led to a much larger set of research efforts by others that show that these peptides also have some influence in human behavior. They've started to look at things like reading social information from the expressions of others."

The affiliation group is one of several so-called "collaboratories" that provide a research environment for about 15 to 20 researchers with similar interests.

In the fear collaboratory, led by Michael Davis of Emory, researchers have studied how we learn to be afraid of

things. They're looking at how systems in the brain in the region called the amygdala are involved in conditioned emotional responses that lead to fear and anxiety, and the way in which individuals can overcome or unlearn this fear. The results hold promise for helping humans overcome post-traumatic stress disorder (PTSD), phobias, and anxiety disorders.

"The brain is plastic: it's made to change and reconfigure as function of experience. One of those changes is to acquire a response, another is to stop that response if it becomes inappropriate or detrimental," explains center co-director Walt Wilczynski. "If you are frightened by something, and it keeps happening but nothing bad happens to you, most people get used to that—they are no longer frightened, they become habituated to it." For example, when a door slams shut once, you may be startled, but if it shuts over and over again, most people ignore it.

Davis and colleagues have studied a protein in the amygdala, called the NMDA receptor, that's involved in habituation of fear. They have found that a drug that makes this receptor work better, called D-cycloserine, can enhance habituation, enabling people to lose their fear faster. D-cycloserine has already been shown to improve psychotherapy for several clinical disorders, such as fear of heights, fear of public speaking, panic disorder and obsessive compulsive disorder, says Davis, and soon it will be tested in PTSD, in which people can't habituate to a fearful memory. "This is a classic example of basic research in animals on emotional conditioning with potential applications for humans," says Wilczynski.

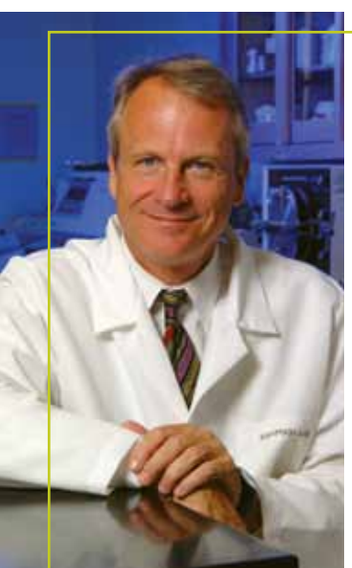
The leadership of CBN currently is planning for life beyond NSF center funding. One of the main legacies of the center is a major increase in faculty lines devoted to behavioral neuroscience. Funding from the Georgia Research Alliance, a government-university-industry partnership, contributed toward building that infrastructure. Over 30 new faculty lines in behavioral neuroscience have been added across all of the partner institutions.

Young adds that the center has had a major effect on student recruitment to the field. "When I first came, most students didn't want to work in behavioral neuroscience because they didn't consider it to be a hard core science. But within just a few years, we completely turned the tides from behavioral neuroscience being unappealing to being a major draw of students," he notes.

What's going to emerge in the future, says Wilczynski, is more emphasis on translational and clinical research—trying to link basic research coming out of our labs with clinical problems. "And also more connections with industry—not only to see the research have an impact, but also for graduate and postdoctoral training. We have to start looking at a range of career choice for people coming out of our neuroscience graduate program."□

FROM THE DIRECTOR

Elliott Albers



Elliott Albers

"In Atlanta, we have developed a community of investigators—we all know each other, we communicate frequently, and we work together on research and educational projects, so it's been a transformation of how we do science here," says CBN director Elliott Albers, Regents professor at Georgia State University and member of the Neuropsychology & Behavioral Neuroscience Program.

These relationships take a long time to establish, "and that's one reason why the NSF STC program really has it right: it gives you ten years," he affirms.

As a result, "we're increasing diversity in the field of neuroscience, developing courses that never would have happened, and we're doing research projects that wouldn't have happened otherwise," says Albers.

"Resources provided by the Science and Technology Center (STC) program allow us to really develop an inter-institutional interdisciplinary center," says Albers. "It's probably impossible to do that in a situation where you don't have some pool of money that's really dedicated to accomplishing that goal."

"Disciplines receive the budget lines at most institutions—biology or chemistry or whatever. And people don't easily give those resources up to an interdisciplinary group. So without some mechanism like this, it just doesn't happen to any significant extent," observes Albers.

We're still struggling in society to find the right balance between single investigator efforts and team science," says center co-director Walt Wilczynski. "Now and in the future, a lot of science will be generated by single investigator grants. The role of centers is to facilitate people doing that, rather than directing people to work together on a particular problem in a top-down approach." Vehicles developed by CBN to promote collaboration, like venture grants and postdoctoral fellows grants, have been key.

"The philosophy of the CBN is that we provide guidance and we can help frame questions in general, but the interactions and particular collaborations are really a bottom-up approach. We facilitate people getting together and we provide resources that provide an incentive for people to collaborate. But exactly what the project is, who those people are, and what their contribution is going to be is really dictated by the individuals involved. There's no way from the top down that you can predict or dictate exactly what an individual should contribute," says Wilczynski.

"There's a big social element in science that's often overlooked, and it's those social bonds that stimulate the collaboration," says Wilczynski.

It's probably not unexpected that a behavioral neuroscientist would analyze team science in that way. Wilczynski laughs and adds, "Just like the studies we do on social bonding, there's a lot of individual variation in that. Some people work extremely well just by themselves and some work extremely well as part of collaborative teams. And we've had both as part of the center."

VIEWPOINT