NATIONAL SCIENCE FOUNDATION

Multidisciplinary Office Spurs Debate

Some of the National Science Foundation's clients in traditional scientific disciplines aren't very happy about a new NSF effort to encourage interdisciplinary research. Although the new initiative hasn't even been formally announced, some physicists have written to Congress that it may drain money from basic research, possibly for projects of interest to industry. And the American Astronomical Society (AAS) is drafting a letter criticizing NSF for not discussing the idea with the scientific community first.

The object of dispute is a $30 million Office of Multidisciplinary Activities (OMA) that is taking shape in the Mathematics and Physical Sciences (MPS) directorate, the largest of NSF's eight major research programs. The office is expected to make grants to small, interdisciplinary teams of academic researchers in optical science and engineering, biotechnology, and environmental science and technology—work NSF officials say either receives insufficient support or does not fit comfortably into existing programs. "This office will be used as a stimulus to look into new areas and to get people to work together," says Tom Weber, executive officer for the MPS directorate and acting OMA director.

The driving force behind the office is Bill Harris, who heads the directorate. Harris already had a small discretionary fund to support unusual or last-minute proposals—data analysis of comet Shoemaker-Levy 9 after it plunged into Jupiter last summer, for example—but the new office will be larger and more visible. Last spring an NSF workshop on opportunities for optical science and engineering recommended an NSF-wide initiative; that led Harris to propose a mechanism to coordinate that initiative with other directorate-wide proposals.

The office will be established through a levy of $5 million or so on the budgets of the five divisions that make up MPS, and division directors will decide as a group which projects to fund. Grants are expected to be a mix of proposals from existing programs and new ideas tailored to the initiative.

Those with questions about the new office say they are still waiting to find out exactly who is eligible and how the money will be distributed. But while they wait, they wonder why NSF is starting a new program when it is struggling to fund existing activities. "This is the worst possible time in astronomy for our basic program to be downsized," says the University of California, Berkeley's, Frank Shu, AAS president, noting the stiff competition for funds among a host of facilities coming on line (*Science*, 20 January, p. 324). "And what we're most upset about is that NSF made a major decision without consulting the people most affected by it." Some researchers also question NSF's premise that multidisciplinary research needs a boost. "I'm not sure that there's something broken here that needs to be fixed," says Bruce Margon, chair of the department of astronomy at the University of Washington.

Other scientists worry that the money may go to research in areas with an obvious short-term payoff for industry. As evidence of that bent, they cite a $5 million program in the new office aimed at placing postdocs and faculty with companies—Grant Opportunities for Academic Liaison with Industry. But NSF officials deny that the office represents any shift from the agency's traditional mission. "It's all fundamental research," says Weber. "We're definitely not creating a program that is designed to produce a new widget in 5 years."

A hint of the kind of worries the program is arousing emerged at a recent hearing of the House Science Committee (*Science*, 13 January, p. 165). Representative Vernon Ehlers (R–MI), a former physics professor at Calvin College in Michigan, said he was concerned about "the diversion of $30 million in basic research money" to the new office, and he asked NSF Director Neal Lane what could be done to "reverse the trend" of shifting money from basic to applied research. Lane replied that NSF remains focused on basic research but that earlier congressional language "sent me a clear message that some [fundamental research] also has relevance to larger societal issues." Ehlers told *Science* after the hearing that several physicists had written to him expressing their unhappiness with the new office.

However, the office also has its defenders. Edward Knapp, president of the multidisciplinary Santa Fe Institute and until recently co-chair of the directorate's advisory committee, believes NSF should be congratulated for creating OMA. "Science has narrowed itself so thoroughly that it doesn't look at very interesting issues anymore," says Knapp, who was NSF director from 1982 to '84. Knapp also praised Harris for giving NSF "a better public relations face," noting that "NSF needs to explain to Congress the relevance of what it funds, and OMA lets it address things that are important to society."

–Jeffrey Mervis

PRIMATE GENETICS

Getting the Poop on Baboon DNA

In a modern tale of straw spun into gold, a team of researchers has extracted the secrets of nuclear DNA from a pile of baboon feces. Although the work might seem unsavory, scientists view it as the key to noninvasive primate genetics studies in the wild and have been trying—unsuccessfully—to get genes from primate dung for several years. But in the 2 February issue of *Nature*, University of Nevada animal behaviorist Julie Constable and her colleagues reveal the scoop on getting DNA from primate poop.

CRAIG PACKER

Inside information. Researchers have been able to analyze nuclear DNA from the dung of olive baboons such as this one.

"It's definitely a breakthrough, and I'm looking forward to using it," says Maryellen Ruvolo, a molecular anthropologist at Harvard University. Two years ago, her lab recovered mitochondrial DNA (mtDNA) from chimpanzee dung. MtDNA, from cellular organelles, is more common than nuclear DNA—but less informative. It is inherited only from the mother and therefore reveals nothing about paternity. Only the DNA from a cell's nucleus, which carries genetic information from both mother and father, can yield a complete family genetic history. "We've dreamed about studying male [primate] mating strategies for years," says Craig Packer, an animal behaviorist at the University of Minnesota and a co-author of the report. "But unless you have some method of actually proving paternity, you can never be certain of who the fathers are."

Feces aren't the straightforward path to nuclear DNA. The direct route is to tranquilize an animal and extract a blood sample. But scientists have been reluctant to do this to endangered species, such as chimpanzees, or forest canopy dwellers, such as gibbons, that might be harmed by a fall from a tall tree. Thus the search for DNA in animal leavings, such as hair or the easily obtainable dung.

But feces have proven to be difficult to study. One of the most serious problems was the lack of primate nuclear microsatellite primers. Primers—previously identified DNA fragments—are used like bookmarks in the polymerase chain reaction (PCR) that amplifies a strand of DNA for analysis; the primers delineate the beginning and end of the specific DNA segment to be amplified. Primers

based on microsatellite repeats—easily recognized patterns of repeated nucleotides—make particularly good bookmarks. And because baboon feces contain a morass of DNA—some from the animal, some from partly eaten plants, some from bacteria—researchers felt that without the proper primers, extracting the right DNA was a hopeless task.

But when human microsatellite primers became commercially available in the last couple of years, Constable decided to tackle the problem for her doctoral thesis. Although not identical to baboon DNA, many human microsatellite sequences are similar to those in the other great apes and very different from other animals. Still, the yearlong project was "so difficult, it almost drove me crazy," she says.

She began by working with dung collected by Packer and his field assistants from 40 olive baboons at Jane Goodall's Gombe Stream Primate Research Center in Tanzania. The first step was to rid the feces of plant compounds that can inhibit PCR. Constable then extracted DNA and used it in a PCR reaction with the human primers. After months of juggling variables such as reaction temperature, Constable eventually was able to amplify DNA from 39 out of 40 baboons.

She then sequenced one locus, D4S243. As a check on the accuracy of the sampled DNA, she compared the DNA from the feces to the same DNA locus from the hair of these baboons. (The hair was collected when the animals were sick and were tranquilized and given antibiotics.) The hair and dung sequences matched, indicating she had not mistakenly amplified a contaminant. The sequenced baboon DNA also aligned with the human sequence for that locus (although there were some differences among the nucleotides), indicating that Constable's primers had bracketed the right target.

Now that Constable has what Packer calls "the smoking gun," she will attempt, by comparing sequences from the male Gombe baboons, to determine which ones have actually fathered offspring and to address the larger issue of male mating strategies. Like many primates, male baboons employ a variety of techniques—from dominating a female to building upon an initial friendship—but without the paternity data, researchers cannot say which of these methods actually results in offspring.

Other researchers want to tackle questions about genetic variability and to use the technique to study other species. "Primatologists are usually trying to dodge this stuff," Packer says, noting that apes have a habit of defecating from tree limbs. "Now we'll be out there with our baseball mitts."

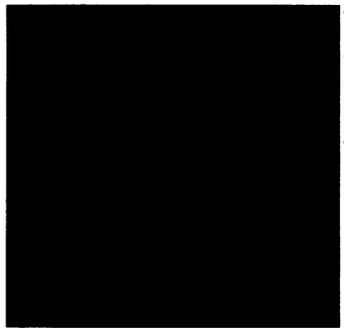
–Virginia Morell

NEUROBIOLOGY

Brain Center Linked to Perfect Pitch

For as long as remarkable mental capacities have been recognized, scientists have strived to find their physical embodiment—usually to no avail. But a research team from Düsseldorf, Germany, may have located the physical basis of one exceptional form of mental performance: perfect pitch—the ability to identify any musical note without comparison to a reference note, a talent displayed by Mozart, among others.

On page 699, a team led by neurologists Gottfried Schlaug and Helmuth Steinmetz of Düsseldorf's Heinrich Heine University report that the planum temporale, a region of the brain cortex that processes sound signals, is far larger on the left side than on the right in professional musicians—and especially in those who have perfect pitch. "It's quite remarkable that one can find a morphology in the brain that is related to perfect pitch," says Robert Zatorre, a cognitive neuroscientist at the Montreal Neurological Institute in Canada.



GOTTFRIED SCHLAUG

Asymmetric. The planum temporale *(red)* is larger on the left side of the brain in musicians with perfect pitch.

The new findings were expected in one respect: They lend additional support to the theory that highly specialized human mental functions occur predominantly on one or the other side of the brain. But in another, they're unexpected, as previous studies, including some of Zatorre's own, had suggested that music is predominantly processed on the brain's right side, not its left.

Schlaug and his colleagues decided to examine the relative sizes of the left and right planum temporale in musicians' brains because previous work had shown that a leftward asymmetry there is associated with mental functions unique to humans, such as language. The neurological basis of music-making is likely to be there, too, says Steinmetz, as music may be "an even higher function" than language. Schlaug, who is now at Boston's Beth Israel Hospital, says the team's interest in the planum temporale was reinforced by a 1950s study of a German musician who suffered melody-deafness after a stroke, apparently as a result of damage to his planum temporale.

The bilateral comparisons were carried out by means of magnetic resonance imaging, which allowed the researchers to measure the volume of specific brain structures. They compared the images of the brains of 30 professional musicians—11 with perfect pitch, 19 without—with those of 30 sex- and age-matched nonmusicians. The left planum temporale was larger than the right in both musicians and nonmusicians. But the size disparity was twice as great for the musicians, a difference almost entirely due to the presence in the group of musicians with perfect pitch.

Schlaug doesn't know, he says, whether the asymmetry and the associated musical talent are inborn traits or whether they can be acquired through training, although results from his and other groups suggest training would have to begin early to be of any use. Studies have shown that 95% of musicians with perfect pitch start their training before age 7, and the Schlaug team found that musicians who began at an older age and who didn't have perfect pitch showed no more asymmetry than nonmusicians.

Although other findings, including some reported just last year by Zatorre and his colleagues in the *Journal of Neuroscience*, suggest that listening to an unknown melody activates parts of the right brain, not the left, the two sets of results may not be as contradictory as they initially appear. "We may well be looking at two aspects of the same phenomenon," says Zatorre. That is, he says, some components of music may be processed in the right brain cortex and others in the left.

If various musical functions are divided in this way, neurologist Albert Galaburda of Beth Israel Hospital suggests that the pitch processing center is on the left because that function requires both verbal and musical skills. He points out that the left planum temporale also includes Wernicke's area, the seat of language comprehension. "My guess is that [the extreme leftward bias in musicians with perfect pitch] has to do with the ability to make the verbal association and say, 'This is a middle C; this is an E flat,' " he says.

The larger question of why brain processing of music is lopsided even in the absence of perfect pitch remains unanswered, however, although one theory holds that processing of complex information may be more efficient if signals don't have to be transferred from one side of the brain to the other. But what is clear, says Schlaug (who doesn't have perfect pitch but was an acclaimed organist before he entered medical school), is that for a musician "perfect pitch is a gift, a real talent."

–Rachel Nowak