RANDOM SAMPLES

edited by CONSTANCE HOLDEN

Sensing Music

Playing music has transformative powers, not only on those listening to it, but also on the brains of the performers—especially, it appears, on the malleable brains of child musicians. On page 305, Thomas Elbert of the University of Konstanz in Germany and Edward Taub of the University of Alabama report that the agile left hands of string musicians—especially those who began training before age 12—are represented by larger brain areas than are the left hands of nonmusicians.

CHRISTIAN STEINER

All those pulsing cells. Emerson string quartet at work, using hands and brains.

The researchers used a technique called magnetic source imaging to measure brain activity when a light touch was applied to the fingers of six violinists, two cellists, and a guitarist. Touching the left fingers of the string players activated a bigger portion of the somatosensory brain area in the musicians than it did in a control group of six nonmusicians.

The difference suggests that musicians' brains had reorganized to devote more neurons to receiving sensations from the left fingers. Just how many more the researchers couldn't determine, but their data suggest it could be two to three times as many. What's more, musicians who started before the age of 12 showed an effect twice as large as did their peers.

An "interesting twist here is the youth," says neuroscientist Tim Pons of the Bowman Gray School of Medicine in Winston-Salem, North Carolina. "If you get them relatively young, you have this increased expansion." Taub says, though, that it is equally important that "plasticity has not disappeared in the older individual. It is just reduced."

This study adds to other work on reorganization of the brain following the learning of a skill. In 1993, for example, neuroscientist Alvaro Pasqual-Leone of the National Institute of Neurological Disorders and Stroke reported an expansion of the brain area receiving sensations from the Braille-reading finger in blind people. And Avi Karni, Leslie Ungerleider, and colleagues at the National Institutes of Health have shown in the brain's motor area what Elbert and Taub found for sensory neurons: When people tap out a well-practiced sequence with their fingers, they activate a greater area of the motor cortex than when tapping an unpracticed sequence (*Science*, 2 December 1994, p. 1475; the study was published in the 14 September *Nature*).

Does having all that cortex devoted to musical—and manual—dexterity make you a better player? "Presumably," says Taub. But "we haven't proved it."

The Violent Side of Low Cholesterol?

Numerous studies have shown that low levels of the neurotransmitter serotonin are associated with suicidal and other forms of impulsive violent behavior. But in just the past few years, researchers have fingered a possible third party in the picture: low cholesterol.

Low cholesterol levels tied to violence? It's "an issue which is real for sure and one that has been overlooked by the cardiovascular people to some extent," says psychiatrist Marku Linnoila of the National Institute on Alcohol Abuse and Alcoholism. That reality is debatable, however: "I'm skeptical about it," says epidemiologist David Gordon of the National Heart, Lung, and Blood Institute.

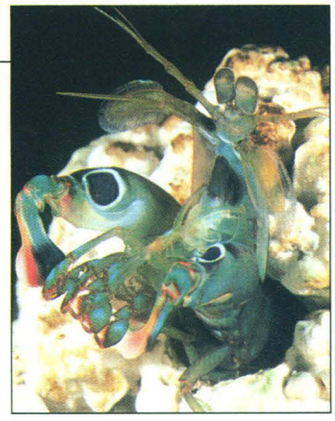
In the most extensive review to date of relevant literature (to be presented next month at a meeting of the Robert Wood Johnson clinical scholars), neurobiologist Beatrice A. Golomb of the University of California, Los Angeles, claims that "Low cholesterol may ... promote violence," and that this link may be mediated by serotonin.

The picture is still patchy. The evidence Golomb cites comes from research with both monkeys and humans. Work by Jay Kaplan of Bowman Gray School of Medicine in Winston-Salem, North Carolina, indicates that lowering dietary cholesterol in monkeys brings out more aggressive, less affiliative behavior. Serotonin levels also go down, he says. In humans, a meta-analysis of six large studies of cholesterol-lowering drugs, done by clinical pharmacologist Matthew Muldoon and colleagues at the University of Pittsburgh, found that people taking medication actually had the same death rates as the controls—compensating for fewer heart-related deaths with more violent deaths.

One explanation for this connection, says Golomb, is that fatty acids in the blood (related to cholesterol) compete with the serotonin precursor tryptophan for binding to serum albumin. Thus, the less fat in the blood, the more tryptophan binds to albumin, and the less tryptophan is available to get to the brain.

Skeptics such as Gordon, however, point out that the effect may not be real at all. The evidence gained was "post-hoc," he says, and was found only in primary and not secondary prevention trials—that is, trials with subjects who already have heart disease. Gordon says, however, that he hopes for more definitive evidence from a trial Muldoon is now just starting, which is specifically designed to evaluate the neurobehavioral correlates of low or lowered cholesterol.

It's a touchy subject, says Muldoon: "So many people have made their career on identifying what's bad about cholesterol."



ROY CALDWELL

Ready for battle. Maybe. Mantis shrimp performs threat display, baring dark purple spots on its appendages, to defend its home.

The Bluffing Shrimp

There are shrimp that fight and shrimp that lie. Twelve years ago researchers at the University of California (UC), Berkeley, reported that weaklings among the mantis shrimp *Gonodactylus bredini* bluff their way out of confrontations by putting on a threat display. Not only were other shrimp confused by the display—it scared them off—but researchers were puzzled as well. If the behavior is successful, they reasoned, all the shrimp would evolve to use it, and then no one would pay any attention to it. Useless, bluffing would be disregarded.

Now behavioral ecologist Eldridge Adams of the University of Rochester thinks he's learned why bluffing persists. In a paper published in the August issue of the *Journal of Theoretical Biology*, Adams and Michael Mesterton-Gibbons of Florida State University explain that the threat display is only cost-effective for some members of the species, and its intermittent use leads to its persistence.

Adams, who has observed more than 500 shrimp fights, explains that the threat display—which involves spreading "raptorial appendages" and showing off big spots on them—offers a large potential benefit for molting shrimp which, having soft shells, would lose any battle they got into. But there are also costs: Making a threat makes you more vulnerable to injury in the event

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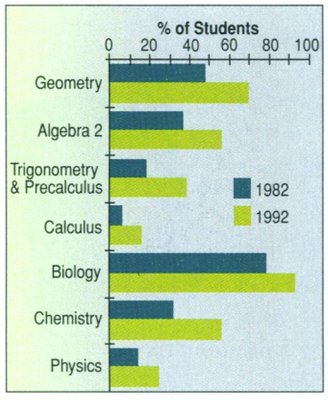
you are attacked. So "animals of intermediate strength" are usually better off not using threats. Thus only the strongest (who have the firepower to back up threats) and weakest use threat displays, and the behavior can persist. It turns out "you can have a stable communication system even if the very weakest is using the threat deceptively," Adams says.

Robert Gibson, behavioral ecologist at UC Los Angeles, calls the case of the fighting shrimp "one of the few well-documented cases of intraspecific deception." What the researchers found, he says, is that its persistence "can be explained by individual variation in costs and benefits."

Report From School Science Front

Those who are pressing for public schools to join the information age may be discouraged to learn that in the U.S. "the average public school spent only $50 on science computer software and $100 on mathematics software in 1993–94." So says a report released last week, "State Indicators of Science and Mathematics Education,"* a biennial production of the Council of Chief State School Officers. It goes on to relate that yearly expenditures for science supplies are generally less than $1 per student.



SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS

Getting numerate. Changes in percent of students taking math and science by high school graduation, 1982–92.

The report is designed to take the pulse of public science education through various indicators, including student achievement scores, course offerings and enrollments, and teacher qualifications. The picture that emerges is a mixed one, although the numbers reflect some of the actions that have been taken following the dire reports about science education and public science illiteracy that have come out during the past decade.

Among the findings, for example, are that "enrollments in science and mathematics have risen significantly from 1982 to 1992" (see chart). And the percentage of high school graduates who have taken math and science courses has gone up as well—from 48% to 70% in geometry, for example, and 32% to 56% in chemistry. "The reform process obviously is resulting in the diminution of low-level courses like 'consumer math' and transition to serious courses regardless of whether students are on an academic or vocational track," says Luther Williams, director of the education directorate of the National Science Foundation, which funded the report.

The report identifies factors it considers most important for student success: They include time spent doing textbook problems ("time on task"), "moderate" testing (somewhere in between daily and never), and "frequent use of calculators." But some indicators don't always tie in with student achievement: In 1994, for example, the District of Columbia led the nation in number of certified math teachers per 1000 students. But its 8th graders were at the bottom of the list on math proficiency.

*The report is available from the Council of Chief State School Officers, 202-408-5505.

Virtual Science Fair

NEWS FROM THE NET

Nils Peterson of Washington State University's (WSU's) College of Education is now running what he calls "the only virtual science fair on the planet."

The fair, which sprang out of attempts to get teachers-in-training hooked up to the Internet, was set up last April. The list of submissions, which closed at the end of September, stands at 109, from 19 schools. Simple-minded "show and tell"–style models won't do, says Peterson. Presenters instead have been instructed to prepare a scientific "poster" with an abstract, a hypothesis, and supporting data and images. It's better than a real poster session, notes Peterson, as "the attachments to the exhibit can be downloaded by the viewer." The youngest participants are second graders in Fairbanks, Alaska, who have two projects: "Snap, Crackle, Pop—Which Rice Krispie Treats Are Best" and "How Much Money Do I Save Turning Off Lights?" In the latter, second-grader Spark Estes draws a path of how he uses lights as he goes through his day. High school entries include "Effects of Music on Animal Learning Patterns," and there are submissions from three education colleges, including "Linear Equations and Rubber Bands." The fair (reachable at **http://www.educ.wsu.edu/fair_95/index.html**) will run from 6 November to 15 December. Project authors will be standing by their electronic posters for dialogues with visitors on Fridays during the exhibit. Biochemist Kevin Facemyer of the education school is already plotting next year's fair. "I think we may institute a more rigorous 'call for papers,'" with screening for merit and presentations like those at real scientific meetings, he says.

Bending Light in Einstein Crosses

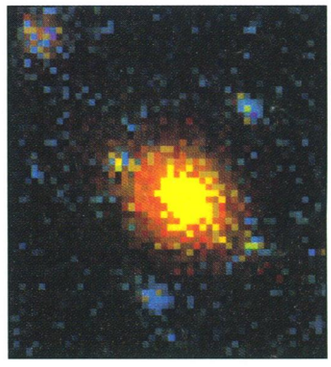
Operating in what astronomers call the "serendipity mode," the Hubble Space Telescope (HST) has discovered two gravitational lenses known as Einstein crosses, in which the light from a distant galaxy bends around a second galaxy, creating four images of the galaxy when the light reaches Earth. The four-lobed patterns should eventually prove useful for testing cosmological parameters such as the rate at which the universe is expanding.

"HST is the clear winner right now" in its ability to detect such crosses, says John Huchra of the Harvard-Smithsonian Center for Astrophysics, who discovered the first Einstein cross from the ground in 1984. With its penetrating vision, the orbiting telescope could eventually double or triple the "dozen good and dozen not-so-good" gravitational lenses known now, he says.

The two crosses were found by Kavan Ratnatunga, Eric Ostrander, Richard Griffiths, and Myungshin Im of Johns Hopkins University, who will report their results in the 1 November *Astrophysical Journal Letters*. The telescope detected the crosses when in serendipity mode, meaning the optical telescope searches star fields that happen to be in its view while other instruments are doing scheduled studies.

By combining measurements of the lobes' angular separation with other information—such as the speed at which both the source and lensing galaxy are receding from Earth—researchers can use the crosses to derive new estimates of the universe's expansion rate.

The Hopkins team still must follow up with ground-based spectroscopic measurements of the cross in order to verify that the four lobes in a given cross indeed come from the same galaxy. And follow-up, says Ratnatunga, will be "tough—even with the best [telescopes] in the world," as the crosses would likely never have been spotted in the first place without Hubble's keen vision.



RATNATUNGA *ET AL.*

Crossroads. Four images of distant object surround galaxy.