A Hand on the Bird—And One on the Bush

A controversial new theory holds that nonhuman primates are "handed" just as humans are

WHAT IS IT THAT MAKES HUMANS UNIQUELY human? Only a couple of years ago many primatologists and psychologists would have agreed that at least one difference between *Homo sapiens* and our closest cousins was the distinctive human preference for using one hand (usually the right) to perform most tasks. And because the left hemisphere of the brain controls language as well as right-handed dexterity, researchers argued that the two might be connected: Our ability to communicate may have evolved from our ancestors' invention of stone tools 2 million years ago. Since hand preferences had never been documented in nonhuman primates, it seemed safe to assume that this trait, together with speech, was distinctly human. "But," says Peter MacNeilage, a linguist at the University of Texas in Austin who has spent much of the past decade developing a new theory of handedness, brain asymmetry, and language origins, "there is now no question that handedness exists in primates."

Not all researchers agree that the evidence is clearcut. In fact, McNeilage's ideas—that hand preferences and, consequently, brain symmetries have been part of the primate lineage for 60 million years—have put him at the center of a hot controversy, which has been debated for several years in the pages of *Behavioral and Brain Sciences*, most recently in the Spring 1991 issue. It didn't take that issue of the journal, though, to rile primatologists. They see linguist MacNeilage as an outsider hoping to correct the experts.

And indeed, MacNeilage has been a critic—charging that the primatologists missed handedness in primates because they gave the animals unchallenging tests of hand preference, typically presenting them with stationary objects that were easily grasped. But the primatologists haven't taken this onslaught lying down. They've fought back with new studies, some of which show handedness, others contradicting that idea. The controversy is far from over, but it has stirred up a very fruitful revisionist possibility in a field that, only a couple of years ago, seemed overburdened by consensus.

The current upheaval began in 1987, when MacNeilage, together with his colleagues Michael G. Studdert-Kennedy, at Yale University's Haskins Laboratories, and Bjorn Lindblom, at the University of Stockholm, first raised the question of nonhuman primate handedness in an article in *Behavioral and Brain Sciences*. Pulling together results from 45 studies on such widely divergent species as bush babies, macaques, and chimpanzees, the three argued that these primates did display hand preferences. Not only would such preferences for specific tasks indicate neurological asymmetry, but they may also have paved the way for the development of language.

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Bush league lefty. *Bush baby grasps tree with left hand, food with right.*

Immediately, MacNeilage and his colleagues came under fire. "People had assumed for years that there was nothing comparable to human handedness in animals," notes James King, a psychologist at the University of Arizona in Tucson. "So when that study came out, it generated a lot of controversy, not only among linguists, but among psychologists and animal behaviorists." Primatologists were particularly unamused. "I think a lot of people's initial reaction was 'Uh-oh, an interloper,'" says Linda Marchant, a primatologist at Miami University in Oxford, Ohio. "What could these linguists possibly know about primates?"

Instead of merely dismissing MacNeilage, however, primatologists and psychologists began reopening the question of handedness—so far with mixed results. While experiments with prosimians and some monkey species seem to confirm the existence of hand preferences, evidence for handedness among the great apes is ambiguous. For example, King and his colleague Virginia Landau report strong left-hand preferences among 18 squirrel monkeys attempting to catch goldfish in a bowl and in a wading pool. Similarly, Jeannette Ward, a psychologist at Memphis State University, noted in a paper in the *Journal of Comparative Psychology* that when ruffed lemurs were faced with the task of retrieving food tossed into a moat, they made 515 out of 516 reaches with their left-hand. Ward documented similar left-hand food-grabbing preferences among six other species of lemurs and two species of bush babies.

But in an upcoming study of chimpanzees in *Current Anthropology* by Marchant and W.C. McGrew, the chimps ferreted out termites with either hand. "It was purely an individual hand preference," Marchant says. "There was no indication of a population bias for one hand or the other." R.W. Byrne and J.N. Byrne, primatologists at the University of St. Andrews in Scotland, also report no apparent hand preferences among a population of wild gorillas they studied in Rwanda.

So the results of the current round of studies aren't unequivocal. But that hasn't discouraged the protagonists of the theory that kicked off the ruckus. Indeed, MacNeilage and his colleagues have moved beyond the question of primate handedness to develop a theory that connects handedness, brain asymmetry, and language in a new way. They call that notion the "Postural Origins" theory for primate brain asymmetries. MacNeilage admits the theory is "speculative " but argues that it offers "a unified view of the evolution of cerebral hemispheric specialization in all primates."

According to the theory, 60 million years ago the earliest prosimians clung to tree branches with the right hand while reaching for food with the left—as lemurs and bush babies usually do today. Thus, the right hemisphere of the prosimian brain was primed (long before humans evolved) for controlling visual-spatial tasks and motor abilities, while the left hemisphere began to specialize in controlling body posture and positioning. Because much of simian communication involves what MacNeilage calls "whole body gestures," requiring great balance in the monkeys' arboreal habitat, he suggests that the left hemisphere began overseeing communication skills and controlling the face and throat muscles used in vocalization.

Later, when the higher primates dropped to the ground and began locomoting on all fours, MacNeilage contends, these patterns persisted. The animals continued to use the right hand for manipulating food, holding fruit to the mouth, and cracking nuts, but they reached for food with the left hand. And vocalization remained the concern of the brain's left hemisphere. Remnants of this pattern are seen in humans today, says MacNeilage. "The link is actually not handedness but footedness," he says. "We have overwhelming evidence now that the left hemisphere's specialization for language is related more to a person's foot preference than to his hand preference." More than 90 percent of humans—including left-handed, right-footers—control language and body posture via the brain's left hemisphere, says MacNeilage.

"As elegant as the tool-use scenario for the evolution of language is, I think it was something far more lowly," MacNeilage concludes. "Language is tied much more to our posture than we realize. But posture is something we take for granted; we never give it a thought or realize that it also requires specialization." MacNeilage may never amass enough evidence to prove conclusively his "Postural Origins" theory, but he is taking on one basic empirical question that could bolster his ideas: hand preferences in chimpanzees. He and a former graduate student have devised a "multi-testing apparatus" that he believes will reveal which hand the chimps prefer for specific tasks. "Acceptance of our theory will be slow," he concedes, "but at least we've given people a relatively coherent framework for looking at some of these questions." Whether all primatologists will be grateful for this gift remains to be seen—as does the question of whether MacNeilage's attempt to draw us closer to our prosimian ancestors by means of body posture will ever succeed. ■ VIRGINIA MORELL

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Gamma-Ray Observatory: Bursting with New Results

The latest satellite data are tearing up established explanations for a longstanding puzzle—the "gamma-ray bursters"

AMONG THE MOST PUZZLING PHENOMENA in all of astrophysics are the intense blasts of radiation known as gamma-ray bursters. Typically occurring about once a day and lasting from a few thousandths of a second to a few hundred seconds, these bursts of intense gamma radiation seem to be the result of powerful explosions somewhere in the universe—but where? Astronomers can't see what these things are coming from since the bursts disappear too fast for anyone to capture them with a telescope. It isn't even clear whether the bursts originate nearby or on the outer reaches of the universe.

Now scientists have new and startling clues to the gamma-ray problem, courtesy of NASA's orbiting Gamma Ray Observatory (GRO). But don't expect easy solutions. In fact, the satellite observations actually deepen the mystery. They reveal a distribution of bursts that is far different from what many theorists expected. And as a result, the most widely accepted current theories are either out the window or in need of drastic overhaul.

The problem with current theories—as revealed by GRO—is that most of them try to explain the gamma-ray bursts as byproducts of catastrophic collapses or shifts in the dense material of neutron stars: burned-out stars whose material reaches densities in which atoms are crushed down to nothing but neutrons. Theorists have suggested that as material falls into a neutron star it could trigger its crust to collapse or even set off thermonuclear explosions—and the energy produced in that way would come out as a gamma-ray burst.

Now, by taking a survey of the distribution of these bursts through space, GRO shows they don't appear to be coming from neutron stars at all. Although neutron stars cluster in the plane of our galaxy and toward its center, the latest observations found gamma-ray bursts distributed randomly through space. Back to the drawing board.

"This result was stunning," says Gerald Fishman, project leader for the Burst and Transient Source Experiment (BATSE), which provided a wide survey. BATSE is one of four gamma-ray experiments launched last April aboard the GRO (recently renamed the Compton Observatory after physicist Arthur Holly Compton). Of the four, BATSE was the most sensitive for detecting weak and brief gamma-ray events, and so far it has picked up 117 bursts.

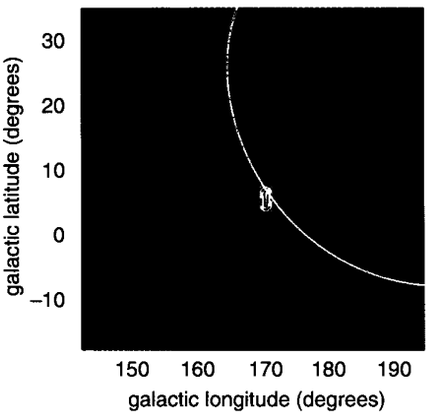

Image of a burst. *GRO detectors can capture angular position but not distance.*

BATSE didn't deliver its knockout punch to the prevailing views immediately, however. The first BATSE results, released last May, seemed to fit the neutron-star idea fine. Those results showed a preponderance of powerful bursts and a lack of weak ones. Since the weak bursts correspond (roughly) to the most distant sources, Fishman says he interpreted those data to mean there were no very distant sources: the bursts came from close by, probably in our galaxy. Further bolstering the galactic neutron star theories, a French-Russian team conducting another experiment claimed that their satellite experiment found that the bursts did line up in the plane of the galaxy—as neutron stars do.

But the latest results turned this neat picture upside down—showing the opposite. And that just didn't jibe with the consensus view. As NASA project scientist Neil Gehrels says, after this latest round of observation, the old theories are "dead or at least in serious need of first aid."

So what is the fate of the neutron star model going to be? Death? Or just a heart-stopping trip to the emergency room? Well, that depends on whom you ask. Even in the face of bad news, some advocates of the current model aren't giving up. For example, both Stan Woosley, a theorist at the University of California, Santa Cruz, and Richard Lingenfelter of the University of California at San Diego say their theories are flexible enough to accommodate the new GRO data.

"There are far too many compelling reasons to believe the neutron star model," says Woosley. Further analysis of the breakdown of energies of these bursts, for example, indicates a source with a strong magnetic field, he says, just like that surrounding