SOCIAL SCIENCE

Evolutionary Psychologists Look for Roots of Cognition

LONDON—Few researchers would dispute that our body's organs and the way they function are adaptations shaped by natural selection during evolution. But for decades, social scientists have regarded cognition and behavior as being exempt from this evolutionary shaping. No longer. Over the past 30 years, zoologists have been increasingly successful at explaining many specific animal behaviors, from mating to foraging strategies, as Darwinian adaptations and thus the products not of a learned skill but of natural selection. Buoyed by this success, a growing number of researchers are now putting human mental activity back under the evolutionary spotlight.

This line of inquiry has led to a remarkable burst of collaboration, with biologists and psychologists trading methods and data, and 30 of them recently gathered at a workshop in London to compare notes. "There's an explosion of new work and a lot of excitement," says behavioral ecologist Marc Hauser of Harvard University. "In many areas of psychological research, entirely new questions are being asked and new answers obtained based on adaptationist thinking," says biologist Alex Kacelnik of the University of Oxford. Hauser and Kacelnik, for example, presented results at the meeting that imply deep evolutionary roots for the mental mechanisms behind numeracy—the ability to assess bulk or amount—and the tendency to discount future rewards in favor of present ones.

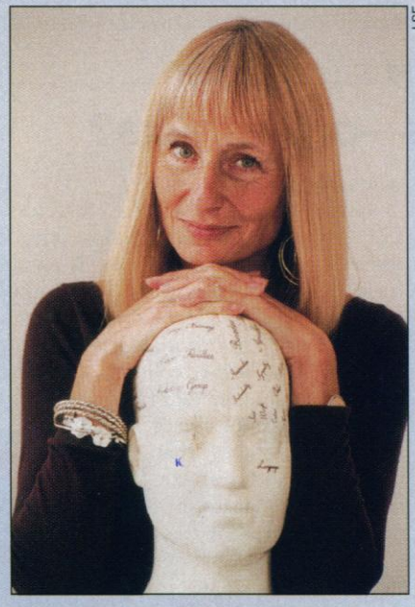
As was evident at the meeting, the new approach still has major problems to overcome if it is to win over skeptical psychologists. "There's a tremendous amount of resistance to the idea human behavior has a biological past," says ecologist Anders Moller at the Pierre and Marie Curie University in Paris. Most important to overcoming the resistance, how can you show that a feature of human mental activity is an adaptation? One strategy is to compare how humans respond to ancient features of the environment with our response to newer features to which we would not have had time to evolve a response. Says psychologist Steven Pinker at the Massachusetts Institute of Technology, "We instinctively fear snakes, but we appear not to be afraid of fast cars, which are a real danger now. This suggests our emotions were shaped by our evolutionary environment, not the one we grew up in."

Another tack is to compare human and animal data to reconstruct how our cognitive features evolved. "We need to pull things out from the nonhuman animals to see which cognitive systems are old," says Hauser. That is the strategy he and others are using to study numeracy, which is common to humans and

Selling Darwinism in a Citadel of Social Science

LONDON—A small office among the clutter of buildings that comprise one of Britain's most prestigious institutes for the social sciences, the London School of Economics (LSE), has a surprising occupant: evolutionary biologist Helena Cronin. As co-director of the LSE's Centre for Philosophy of Natural and Social Sciences, Cronin could have quietly got on with her studies in the philosophy of biology, but given her unusual surroundings she decided it would be a shame not to spread the word.

Cronin, who is a champion of Darwinism as a way of understanding both biology and human affairs and author of an authoritative book on evolution, decided that the LSE might benefit from more exposure to Darwinian thinking. The social sciences, she figured, could gain a far better insight into how people behave and how societies work by supplementing their exploration of the cultural factors in human behavior with a look at how evolution shaped our minds and bodies.



LSE

Getting a grip on the mind. Evolutionary biologist Helena Cronin of the London School of Economics.

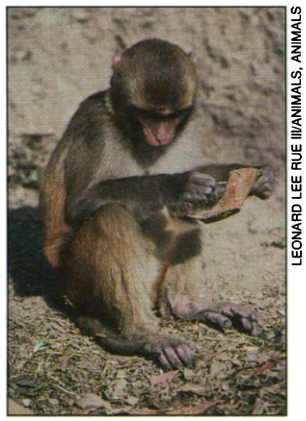
Three years ago, Cronin launched this campaign on her unsuspecting colleagues by organizing at the LSE an ambitious conference entitled "Darwin and the Human Sciences." The conference was packed and attracted a distinguished group of speakers from scattered disciplines. And surprisingly, there has been no outright opposition from her colleagues, she says.

Following this success, Cronin began a series of Darwin Seminars at the LSE last year. The series kicked off with psychologist Leda Cosmides of the University of California, Santa Barbara, talking about adapted minds, and evolutionary biologist John Maynard Smith of the University of Sussex on the evolution of language. "We had no idea how much interest there would be and booked a room for 50 people," she says, but found "people were sitting on the stairs queuing to get in. We hastily got a bigger room."

With 14 seminars now under her belt, covering topics as diverse as sexual attractiveness, medicine, and war, "we've never looked back," she says. The latest seminar, held last month by psychologist Susan Blackmore of the University of the West of England, looked at how evolution may have shaped our psychology. This attracted some national radio publicity, and Cronin had to change venue rapidly and book the biggest room at the LSE, holding 350 people.

Social scientists are taking note, says LSE psychologist Andy Wells. "Darwinian models are of great importance, but it is too early to judge how significant their impact will be," he says. Sociologist Christopher Badcock of the LSE, who founded a course focused on a Darwinian perspective on the subject 10 years ago, says it was a bitter struggle to set up the course because of hostility from colleagues. But with the decline in popularity of Marxist approaches and other political developments, he says, "things are changing gradually, and there's huge interest now among the students." –N.W.

some animals. Psychologists have found that infants aged less than a year display basic numeracy. For example, in work discussed at the meeting, Arizona University psychologist Karen Wynn studied the response of infants aged 8 to 10 months when two similar dolls are placed behind a screen and one of the two dolls is sometimes missing when the screen is lifted. Wynn found that infants will look at the single doll for much longer, apparently puzzled by the disappearance of the second doll. This suggests infants can do simple arithmetic and memorize objects before language competence develops.



LEONARD LEE RUE III/ANIMALS, ANIMALS

Go figure. New research suggests that rhesus monkeys can do simple arithmetic.

Hauser and his colleagues tested a colony of semi-free-ranging rhesus monkeys for the same skills with pairs of bright purple eggplants. They found that, like infants, these Old World monkeys looked longer at the impossible outcome—when two fruits were placed behind the screen but only one was present when the screen was removed. "From these results, adult rhesus monkeys and 8- to 10-month-old human infants appear to have comparable abilities for simple arithmetical computations," says Hauser, implying that this skill is hardwired in the brain.

The evolutionary programming may have taken place long ago, because Hauser observed similar responses in New World monkeys—a captive colony of cottontop tamarins. If the observed behavior is a common adaptation, it dates back to before the divergence of these primate groups, and hence long predates the emergence of humans. "Comparative studies using similar methods are vital to help study which cognitive abilities are evolutionary adaptations," says Hauser.

Oxford's Kacelnik is finding an even deeper evolutionary root for the human tendency to "discount" future events—trading off the value of opportunities in the future for rewards now. He and his colleagues carried out a study of discounting in captive starlings, using a test system varying the size and delay of food rewards. They found a distinctive pattern of behavior in which the perceived value of future rewards diminished rapidly with time, on a hyperbolic curve that gave high value to short-term gains and maximized the rate of reward rather than its overall value.

Kacelnik compared these results with a number of studies of human discounting and found the pattern of response was remarkably similar to that in the birds, suggesting that the tendency to maximize short-term rewards may have an evolutionary root and that "play today" has been a successful strategy in the past. Although similarity alone does not prove an evolutionary link—the same kind of behavior could have evolved independently in humans and starlings—Kacelnik believes such results will lead to further tests of animal and human behavior. "A key challenge for adaptationist thinking is to produce precise predictions about psychological mechanisms," he says.

But already, advocates of a Darwinian approach to psychology are emboldened by their successes. They are carrying the search for built-in psychological adaptations to questions ranging from the psychological differences between males and females and conflicts of interest between parents and offspring to morality and political behavior. Says psychologist John Tooby of the University of California, Santa Barbara, "People come factory-equipped. There's stuff built into brains."

–Nigel Williams

PHYSICS

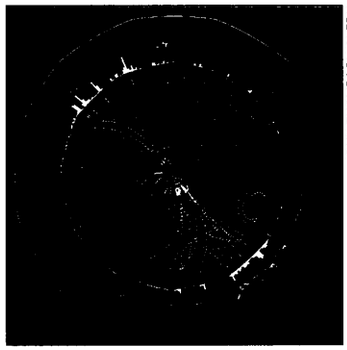
Improbable Particles—or Artifacts?

"When you have eliminated the impossible, whatever remains, however improbable, must be the truth," wrote Sir Arthur Conan Doyle. Eliminating the impossible is just what researchers at CERN, the European Center for Particle Physics, are now trying to do. *Science* has learned that over the past year, one of the four huge detectors on the Large Electron-Positron Collider (LEP) has picked up 18 unusual events that don't fit into any known physics, yet are so tantalizing that, so far, physicists can't write them off.

In each case, the ALEPH detector recorded four jets of mesons and similar particles spraying from high-energy collisions of electrons and antimatter positrons. The total mass of the daughter particles always added up to 106 billion electron volts (GeV), but the two pairs of jets made unequal contributions. This pattern could imply that a short-lived pair of dissimilar particles lived briefly after each collision before decaying to produce the jets. But existing physics has no candidates. "This large peak that ALEPH is seeing is completely unexpected from the Standard Model point of view," says CERN theorist Carlos Wagner. Nor do the events fit neatly into popular extensions of the existing theory, such as a scheme called supersymmetry.

Odder still, the other three detectors on LEP have seen nothing comparable. "It's somewhat bizarre that, if there is anything there, they are seeing nothing," says ALEPH's spokesperson-elect Peter Dornan, an experimentalist based at Imperial College London. Now, with the help of colleagues from other detector groups, the ALEPH researchers are trying to determine which is more improbable: that they have made a mistake, or that the so-far-inexplicable events are real.

ALEPH researchers noticed the first events in data taken in 1995, when LEP was colliding electrons and positrons at energies of about 130 GeV. Following a standard analytic procedure, the researchers scanned the debris of the collisions for distinct particle jets—the signatures of decaying massive particles. Certain four-jet events are a special prize, because they might signify the production and decay of pairs of hypothetical particles predicted by extensions of the Standard Model. But some of the four-jet events the researchers did find didn't fit any predicted pattern (*Science*, 26 April 1996, p. 474).



JOHN THOMPSON/ALEPH

True colors? In this view down the LEP beamline, four jets of particles *(colors)* spray from a collision in the ALEPH detector. The odd pattern of jet masses could point to new physics—or to an experimental artifact.

At first, many physicists were inclined to dismiss these first few events as a fluke that would vanish with more data when LEP restarted late in 1996. But now that these new LEP runs, at energies of 161 GeV and 172 GeV, have been completed, "a few more events have come along. When it's all added together, this effect looks more significant, so this is what's now creating the excitement," says ALEPH researcher John Thompson of the Rutherford Appleton Laboratory near Oxford in the U.K., who in mid-December presented the ALEPH events to a meeting of about 100 theorists there. Thompson and his colleagues think it's unlikely that they've made a mistake, but theorists say it's