# Tool-Using Crows Give New Meaning to Term 'Bird Brained'

By Richard Karel

Thinkers as diverse as Freud and Carlyle have long pointed to tool use as one of the defining behaviors of man.

In *Civilization And Its Discontents* Freud wrote that tool use was among mankind's first acts of civilization. And 19th century essayist Thomas Carlyle observed that "man is a tool-using animal. Without tools he is nothing; with tools he is all."

But tool use is by no means unique to man. Primatologists have presented convincing evidence that chimpanzees exhibit a fairly sophisticated capacity to modify sticks for use in foraging. A survey of the animal kingdom shows that use of naturally occurring items as tools is not even confined to more evolved species. Wasps, for example, have been observed using sticks to tamp mud, according to University of Vermont biologist Bernd Heinrich, Ph.D., author of *Ravens in Winter*.

The manufacture of tools for a specific purpose, however, is something generally associated with man.

Now comes Gavin Hunt, Ph.D., of Massey University in New Zealand with an intriguing report on the manufacture and use of tools by crows. The report was published in the January 18 issue of the journal *Nature*.

While tool use among birds is not unheard of, Hunt's New Caledonian crows, close kin to American crows, were observed employing two distinctly different kinds of tools to forage for invertebrates such as insects, centipedes, and larvae. Such specialization in tool manufacture has not heretofore been observed in nonhuman animals, according to Hunt.

The observations occurred between November 1992 and March 1995 in New Caledonia, a group of islands 900 miles northeast of Australia. Hunt observed both manufacture and use of a hooked tool made by plucking and stripping a barbed twig. He also observed the use, but not manufacture, of what he described as a "stepped cut tool" with serrated edges. He did, however, observe and photograph leaves from which crows had started to cut such stepped tools.

The findings add to the growing debate over cognition in nonhuman animals. While man, in Shakespeare's words, may be "the paragon of

animals," Hunt's finding suggest that that the capacity for thought exists on a continuum where man is not unique.

Zoologist Christophe Boesch, Ph.D. notes in an accompanying commentary in *Nature* that "all current theories about the evolution of mankind rely on tool manufacture and use as being central behaviors that distinguished our earl ancestors from apes." While there is evidence of crude and nonstandardized tool use in *Homo habilis* 2 million years ago, it is only with the appearance of *Homo erectus* about 1.8 million years ago that standardized and relatively sophisticated forms of tool use are found, notes Boesch.

Hunt's report suggests that the tool-making and tool-using behavior of crows rivals that of *Homo erectus,* although the issues, Boesch notes, "are not straightforward." He argues that chimpanzees have shown a level of tool manufacture and use comparable to that described by Hunt.

Mark Hauser, Ph.D., is an associate professor in psychology, anthropology, and neuroscience at Harvard University. He is the author of *The Evolution of Communication,* which will be published by Massachusetts Institute of Technology Press this May.

The similarity of tool manufacture and use in crows to that in man is the outcome of a process called "convergent evolution," according to Hauser.

Convergent evolution may occur when different species confront similar ecological problems to which there are limited solutions, said Hauser. Under such conditions, similar solutions may arise.

"The classic problem with any kind of tool use and social transmission in the wild is that you can never be sure of the mechanism by which the invention came to pass and how it got transmitted to the population," said Hauser. "The real question is, 'What is it?' At some level there has to be some kind of cognitive computation going on because it's not an automatic sequence." What is "becoming more and more apparent in the literature is that it doesn't make sense to talk about general intelligence but brains designed for special purpose," he continued.

Different animals have "different capabilities," observed University of Vermont biologist Heinrich. "Animals are smart in their own restricted way. They are more like idiot savants. Each animal is an idiot savant in its own medium."

Gregory Ball, Ph.D., is a behavioral neuroendocrinologist and associate professor of psychology at Johns Hopkins University in Baltimore. From the perspective of comparative neuroanatomy "people often talk about bird brains as if birds have small brains, but certain orders of birds have quite

large brains for their size," said Ball. Corvids, the family of birds that includes crows, ravens, and jays, have large brains for their body weight, Ball noted.

Birds and other nonhuman vertebrates "may have greater behavioral plasticity than we realize and may engage in some forms of simple planning to solve problems," Ball said. "How that's represented in their brains, how they learn to do this, could give us fascinating insights into the basic brain mechanisms that mediate these activities. It could be that the same mechanism are present in humans and that we then built upon these."

Anthropomorphically, said Ball, "we try to say they have thoughts like we do. But the difficulty comes in that we put conscious thoughts into language. The challenge comes in how to understand how they could have cognitive thought without language."

But Heinrich does not see language as critical to cognition.

"I think a lot of people get so hung up on language that they can't see beyond it," said Heinrich. "In some ways, words get in the way and slow down your thinking," he commented. We all frequently think symbolically and visually without the use of either internal or external language, Heinrich noted. Nonhuman animals may do the same.

Heinrich ha studied the crows' first cousins, ravens, extensively. With ravens, "my impression is they basically respond to emotions," he said. "In this case I don't see you necessarily need to evoke cognition."

Irene Pepperberg, Ph.D., is an associate professor of psychology and an associate professor of ecology and evolutionary biology as the University of Arizona in Tucson. She has received widespread recognition for her ongoing work showing that an African Grey Parrot named Alex is able to learn referential speech, not mere mimicry. In working with parrots, she has even found a rudimentary capacity for quantification indicating they are able to understand numerical groupings of up to six, Pepperberg told *Psychiatric News*.

Hunt's observations on the New Caledonian crows are not sufficient to determine whether the tool manufacture and use is transmitted genetically, culturally, or a combination thereof, she noted. "The interesting thing would be to devise experiments that would require slight modifications of these tools, and see if or how quickly they learn to modify [them] for different situations. One of the hallmarks of cognitive capacity is flexibility."

## *[Sidebar]* What Bird Brains Teach Us—And Don't

A report by New Zealand biologist Gavin Hunt, Ph.D., that New Caledonian crows make and use a tiny tool kit to forage in otherwise inaccessible nooks and crannies suggests that insightful problem solving many not be unique to man or higher primates.

It is tempting—and scientifically risky—to anthropomorphize the crows' behavior. At the very least, however, Hunt's observations raise a host of intriguing questions.

"This paper fits into a long series of papers that have pointed to the idea that there is not a qualitative difference between certain aspects of cognition in human and nonhuman animals," said Gregory Ball, Ph.D., a neuroendocrinologist at Johns Hopkins University.

Corvids—the family of birds that includes crows, ravens, and jays—are not bird brained in the popular sense if one considers the ratio of brain to body weight, Ball notes.

In a recent lecture at the National Zoo in Washington, D.C., Irene Pepperberg, Ph.D., a cognitive ethologist at the University of Arizona known for her work with learning in African Grey parrots, explained that neuroanatomists originally misconstrued the potential for intelligent behavior in birds because birds have a very small cerebral cortex. Since that part of the brain is associated with higher intellectual functioning in man and other mammals, the assumption was that its diminutive size rendered birds incapable of truly intelligent behavior. But scientists now have evidence that in birds, the striatal region assumes many of the functions performed by the cerebral cortex in mammals, Pepperberg said. Birds also have a well developed hippocampal region, which is thought to be critical to memory and spatial learning ability.

"I think that there's a general tendency to underestimate the abilities of animals, especially nonmammalian vertebrates," said Ball. "Those of use who study them carefully are more and more impressed by what they can do as opposed to what they can't do."

While it is not clear that the crows actually know what they are doing, the capacity to make and use two different kinds of tools is "very impressive," commented biologist Bernd Heinrich, Ph.D., an expert on corvid behavior. Heinrich cautioned that it is very difficult to demonstrate the existence of insight and foresight when observing apparently intelligent behavior in birds.

Whether or not avian intelligence can be explained in human terms, observations like Hunt's are uniquely valuable, said Ball. "I think a lot of important insights into basic brain mechanisms in relation to behavior come from comparative studies like this, and many people in the biomedical community don't appreciate the utility of them."

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