New research sheds light on cognitive abilities of animals

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Recent research has begun to investigate the cognitive abilities of animals, such as their capacity to understand language, and is helping to identify the evolutionary developments made by human beings that began to distinguish them from apes.

Scientists recognize specific skills as key signs of high cognitive abilities; they include good memory, self-awareness, an understanding of grammar and symbols, understanding others' motives, imitation, and creativity. Just like humans, animals need these cognitive processes to interact with the changing world around them to survive.

"They need to be able to distinguish colors to know when a fruit is ripe and unripe," Irene Pepperberg, an adjunct professor and psychology researcher at Brandeis University, told *National Geographic*. "They need to categorize things – what's edible, what isn't – and to know the shapes of predators. And it helps to have a concept of numbers if you need to keep track of your flock, and to know who's single and who's paired up. For a long-lived bird, you can't do all this with instinct; cognition must be involved."

Language and the ability to adapt to environments are a major component of culture and social cooperation, and as far as we now know, are restricted to humans. Some early studies on apes have shown that they can acquire a basic vocabulary of English words to communicate. But none of these studies demonstrated that they had learned language in the sense of using words as symbols to discuss feelings, the past, the present or to collaborate in groups, as humans do. Researchers are now beginning to investigate other species.

The journal *Behavioral Process* has recently published the findings of Dr. John W. Pilley with his replicated experiment to teach a dog speech. The original experiment was performed by a German man and his border collie named Rico, who was the object of study for Dr. Juliane Kaminski. Rico was able to recognize 200 different objects, mostly balls and toys. Dr. Pilley, testing his experiment on another border collie, used his own method that he had come up with while he was teaching at Spartanburg, South Carolina.

He bought a border collie puppy in 2004, named her Chaser, and started training her every day, four to five hours per day. Dr. Pilley's method consisted of showing the collie an object, while repeating its name 40 times, then hiding the object while continuing to repeat the name of the object. Using this method, he could teach the dog the names of one or two objects per day, which had to be reinforced at later times.

The point of this experiment was simply to see whether Dr. Pilley would be able to teach another border collie the names of more objects than Rico had been able to learn. Chaser was able to learn 800 cloth animals, 116 balls, 26 frisbees and a medley of plastic items in just three years and enjoyed her drills so much that she demanded more.

Chaser learned words at a much slower rate than a human child. Children learn on average 10 words per day, and by high school they have a vocabulary of about 60,000 words. One advantage is that humans have an ability to associate objects with each other and with actions, for example forks, spoons, and knives, whereas Chaser learned each word separately.

Once the dog's knowledge reached 1,000 objects, Dr. Pilley focused his attention on grammar. The question to answer was whether given the command to fetch-ball or fetch-frisbee, Chaser would be able to understand the word "fetch" separately from the object being fetched.

To test this question Dr. Pilley taught three different actions: paw, nose, and taking an object. Presented with three of her toys, the dog was able to correctly paw, nose or fetch the appropriate toy when the command was given. "That experiment demonstrates conclusively that Chaser understood that the verb had a meaning," Dr. Pilley told the *New York Times*.

She was also able to learn categories, for example being able to follow the command of "fetch a ball" or "fetch a frisbee." Exclusion was also not beyond her capacity. When given the command to fetch an object she did not know the word for among objects she was familiar with, Chaser was correctly able to grab the toy that she did not know.

The hypothesis is that these experiments can help to determine how children acquire language, since the theory is that children build on the same neural mechanisms. Yet, these comparisons are in dispute since animals are thought to link the sounds of the words to an object through sheer repetition. Chaser was taught proper nouns instead of common nouns. The

latter are abstract and are understood by children, but children learn through social interaction, not just continuous repetition. According to Dr. Kaminski, the research could not show that dogs are in any way learning to understand language, unless the dogs were able to understand the meaning of a sentence when it is in a different order.

Dr. Pilley is attempting to do just this. “We’re trying to teach some elementary grammar to our dog,” he told the *Times*. “How far we’ll be able to go we don’t know, but we think we are on the frontier.”

Professor Pepperberg is one of several people doing similar work with other species of animals. Her African grey parrot Alex knew about 400 words, which he used to convey his desires and feelings. Unlike dogs, he had the ability to form sentences and in some instances even new sentences. He was also able to comprehend categories such as big, small, same-size and absent.

According to Pepperberg and her colleagues, Alex had the emotional equivalent of a two-year-old child and the intellectual equivalent of a five-year-old child. More specifically he had the language abilities of a two-year-old child and the problem-solving abilities of a five-year-old child. The most fascinating observation was that Alex would “practice” how to pronounce words without the incentive of receiving rewards and would scold other parrots for mispronouncing words or give them the wrong answer. This suggests that he was able to self-correct and teach.

These studies build on the pioneering 1967 work on language acquisition by Allen and Beatrix Gardener with a chimpanzee named Washoe. Previous experiments in teaching apes how to speak the English language had failed due to their inability to make the correct sounds, so the Gardeners decided to teach her American sign language (ASL). Washoe was taught just as one would a deaf human child, interacting with her and other humans around her only in sign language.

It was a successful experiment. Washoe learned approximately 350 words of ASL, picking up some without operant conditioning methods, and assimilating them into her daily life of communicating with humans and other apes that were in the study and some that were not and couldn’t understand what she was signing.

Not only were these communications videotaped, but the researchers were also able to tape Washoe teaching her adopted son Loulis sign language. The humans in close contact with both mother and infant were strictly forbidden to use sign language in front of Loulis. It was found that Loulis learned through direct imitation of the symbols and through Washoe’s direct modeling of the activity, or showing the object to the infant ape while signing the word for it at the same time. Notably, this shows the ability of animals to teach other animals.

Micheal Tomasello, director of the Leipzig Centre’s department of developmental and comparative psychology, explained that the evolutionary advance that humans have made is our ability to connect with the mind of other humans. “If you raise a human baby on a desert island outside of any kind of culture,” Tomasello said, “that child’s cognitive abilities as an adult would be very similar to other apes. What’s really different is something in the direction of culture. All of the things we consider our highest achievements, including language, symbolic mathematics and social institutions like governments and universities … these are cultural products. This isn’t one person’s brainpower. These are collective efforts.”

Most of Dr. Tomasello's research focuses on the behavior of apes and monkeys. He has found that humans are the only apes that evolutionarily have a very egalitarian way of behaving, which some believe stems from foraging in groups. To do this humans have developed language, which enables them to cooperate with each other, whereas apes do not tend to work together unless there is an immediate benefit for the self. For example food sharing among apes is a very rare phenomenon. Even among captive animals or primates in the wild that have killed another creature using a group tactic, there will always be fighting over and stealing of food. It is never willingly shared, except in the rare occasion between a mother and its infant, in which case the infant—100 percent of the time, according to Tomasello—is given the least palatable part of the food.

Humans are the only animals that have developed culture. We produce things through our labor for each other. Language is an absolute necessity when you live socially, where individuals work for each other, exchanging the products of their labor, and need the ability to communicate in the clearest way possible.

It may just be that these exceptional animals, who have learned large numbers of words, are not as remarkable as they appear to be; they have had the privilege of an immense amount of human attention and patience lavished on them. In a similar environment other animals might be able to attain the same level of cognitive ability.

Yet the fact remains that their cognitive achievements did not evolve spontaneously out of millennia of social collaboration as did the cognitive abilities of humans. These achievements by animals are themselves the product of human social practice.