Sofia`s world

Mongrel differentiates phrases with two terms and uses keys to communicate with humans

Marcos Pivetta, January 2006

Sofia is not a highly gifted dog. Of no defined breed, small in size, with about 5 kilos, she would pass unnoticed in a pack of mongrels. But, in the course of 4 years of life and hundreds of training sessions, she has developed one or two skills that make her special for a group of researchers from the Psychology Institute of the University of São Paulo (IP/USP) specialized in animal behavior. Sofia understands and differentiates, with a reasonable degree of success, phrases made up of two distinct terms, like “fetch ball” and “point stick”, and she communicates with human beings by means of a special keyboard, on which arbitrary signs represent objects or actions aspired to by the animal. Printed on one of the eight keys of this electronic panel, a set of vertical black stripes, for example, symbolizes the wish to take a walk in the company of the owner. Instead of pointing to the gate onto the street, as the majority of dogs do, this dog, when she wants to go out, activates on the electronic panel the key equivalent to a walk and begins to stare at her instructor, as if to say “Hey, I want to go for a walk”. The gesture is made only when there is a human nearby, and, according to the researchers, it has the nature of a communicative signal, and not a simple conditioned response.

New studies, like the works with Sofia, suggest that the cognitive process is more refined in our four-pawed friends than used to be thought. Dogs could be located in the tradition of the so-called “linguistic” animals, like the chimpanzees, bonobos, dolphins and parrots, in contact with man, capable of acquiring communication systems by arbitrary signals. They may not go so far as being as “intelligent” as monkeys, but they surpass them in certain communication skills, such as the interpretation of human gestures and looks. When a 4-year old bitch uses a keyboard to send a message to her trainer, or when she responds appropriately to multiple commands, this act denotes a capacity for abstraction and association of ideas similar to the process of learning words by children. “The dogs’ potential for understanding human language is frequently underestimated or dealt with in a folkloric manner”, says Cesar Ades, a specialist in animal behavior from the IP/USP, who is coordinating the researches with the mongrel. “Dogs are not more intelligent than wolves (Canis lupus), from which they descend. They just communicate better with people.”

The choice of Sofia for a long-term study about canine cognition was not a random one. “We chose a mongrel precisely to escape from the breeds that have a reputation of being more intelligent”, explains zootechnician Alexandre Pongracz Rossi, a master’s degree pupil of Ades. “We didn’t want to work with a dog prodigy.” The bitch was acquired in October 2001, with the specific purpose of participating in a research program that aimed at replicating experiments done with other “linguistic” animals. She was separated from her mother and her six siblings when she was 50 days old and began living as a pet in Rossi’s house. Her training was done in the laboratories of the IP/USP. A complex conditioning program was drawn up, with a precise quantitative record of all the stages, with a view to evaluating two of the animal’s domains of communicative competence: the capacity for understanding phrases of two terms (action/object and object/place (and the capacity for producing signals at the keyboard. The first line of work was run by Daniela Ramos and Léa Yuri Suenaga, who are studying for a master’s degree, and the second, which will be taken forward by another student for a master’s degree, Carine Savalli Redigolo, by Rossi himself.

The researchers were surprised with the dog’s performance in the majority of the tests. After being duly trained, Sofia would respond to a verbal request made up of two terms with a degree of success better than chance (this capacity is distinguished from the simple response to unitary commands, like the order to sit, generally used in dog training). The first word of the request designated the object that was to be the target of the action (ball, key, stick or bottle) and the second, the behavior expected of the animal (fetch or point). Combining the two terms, there were, therefore, eight distinct possibilities of command. To start with, the requests were always made in the object plus action order (key fetch, bottle point and so on). At a second moment, the order of the terms was inverted (fetch key, point bottle etc.) to see if the dog was not responding to the combination of sounds as if it were a unitary command. The alteration did not affect Sofia’s performance. The place of the tests, the person giving the commands, and the objects or actions involved in the experiment were also changed. No modification made the bitch behave in a different manner. “We believe that Sofia retains the two pieces of information, on the object and on the action, and manages to correlate them”, explains Ades. “Her behavior does not derive from a simple conditioning, of the stimulus-response kind.” The dog was also capable of combining the information contained in commands in which one of the terms indicated an action and the other where this action should be performed (whether to the right or to the left).

Like her response to verbal orders with two terms, Sofia's good performance in the tests with the electronic panel also indicates that dogs may be more "linguistic" animals than is imagined. The dog learnt to communicate its wish to carry out seven different actions – to take a walk, to win a toy, to take a pee, to go to his bed, to ask for food, to drink water and to be given affection – by activating the respective buttons associated with these behaviors. The panel has eight keys, and seven of them were associated with seven distinct acts (one position remained without a function). The symbols present in the positions were arbitrary and did not show any direct connection with the action desired by the bitch. This avoided representing affection with the drawing of a hand on a dog; nor was the act of playing associated with an illustration of a ball. The Food key, for example, contained only a black rubber cross, and the Toy key, a small yellow circle.

The mongrel, which was rewarded for the correct activation of each key by her request being attended to, used the new communication interface with aplomb. On about 300 occasions, she pressed down with one of her paws the command equivalent to the action she wanted to perform, an act that depended on human assistance, from her trainer, to be put into effect. Sofia would look in a more meaningful way at the trainer after having pressed a key than before, as if she was waiting for a reaction on his part. She would also frequently look at some object related to the desired action, like a bottle of water when she was thirsty, or the gate to the street when she wanted to go for a walk. "We believe that Sofia is capable of learning concepts and evoking them with the keyboard", says Rossi. "We were surprised when she activated the Food key when we showed her a live guinea pig for the first time."

Domestication – The mongrel would activate the buttons of the panel spontaneously – she would press down, for example, the Food key after a walk, or the one for affection in the presence of Rossi – or before an external incentive (the researcher would show her a toy, and the animal would press the corresponding button, or the dog had eaten, and she would press down the Food key). Control observations showed that Sofia's performance would continue to be significant, even when the relative position of the keys on the panel was changed. For the researchers, the bitch's behavior is not merely the fruit of the conditioning to which she was submitted (Rossi is a famous animal trainer in Brazil). After all, the dog would only activate the panel in the presence of a person. "Of course, Sofia's actions reflect, in part, her training, but in part they are efforts to communicate with man", Ades ponders. "Now we want to see whether Sofia is capable of drawing absent objects, a function typical of human language, and whether the use of the keyboard increases when she realizes that someone is paying attention to her."

A companion in the hunt, a herder of cattle, a guardian of the home, and man's best friend, dogs have been the ugly duckling in studies on cognition and animal intelligence for decades, always outshone by the work done with dolphins, whales and non-human primates, above all chimpanzees. Could they be, contrary to what their owners usually think, too stupid by nature or by human domestication? Certainly not. But there was a core resistance against researches into the behavior of dogs that remained insurmountable for decades: the idea that it was not worthwhile to study the communication of an animal that had lost its original habitat and practically no longer existed in its wild form. Meaning, for this line of thought, that Canis familiaris was discarded as a noble object of ethology, the branch of science that studies the behavior of animals in their natural habitat, not because it was a dog, but because it was too familiar to man. An acculturated being, outside its place in nature.

Since the 1990s, this view has been left behind. What used to be a disadvantage has become today the great differential of the works with dogs. After all, this is the only animal species, besides the cat, that has evolved alongside man. Its natural niche is nowadays the same as the human being's. Nobody knows for sure when its process of domestication occurred, an event that probably took place in Asia between 15 thousand and 100 thousand years back (the data is uncertain and debatable).

This change of view about the inclusion of Canis familiaris in the world has increased tenfold the quantity of scientific articles about the behavior of the species in the last few years. One of the recent articles that had most repercussion, in the media outlets as well, was an article published in June 2004 in the famous American magazine Science by researchers from the Max Planck Institute for Evolutionary Anthropology, in Leipzig.

In the study, the team of German researchers described the cognitive skills of Rico, a border collie, a breed with a reputation for being intelligent. Targeted for extensive training, the dog, then 9 years old, had mastered a vast

“vocabulary”: his trainer would say one of the 200 words known by the dog, and the dog would fetch the object or toy designated by the human voice. Rico was also capable of associating a new word to a new object. This form of learning, called technically fast mapping, is comparable to the way that 2 or 3-year old children incorporate terms into their repertory.

Few people doubt nowadays that there is much to be learnt with dogs, not only in the area of the comprehension and production of communicative signals, but also in the field of studies in comparative genetics (see the article below about the sequencing of the genome of man’s best friend). “The greatest challenge today is to understand the limits of the skills of dogs and how they, with a cognitive system that is probably simpler than ours, can ‘simulate’ behaviors to interact with humans”, says ethologist Ádam Miklósi, from Eötvös University, in Hungary, one of the great scholars of the theme. Like his colleague Cesar Ades, from USP, Miklósi belongs to the lineage of ethologists for whom the dog’s capacity for communication with man was a decisive element in its process of domestication. He argues that dogs are good at perceiving visual signs and clues given by humans, not because they have enormous mental skills, but rather because they are more interested in us. “Dogs direct their gaze to the human being as no wolf does”, comments Ades. This perhaps explains why the dog, and not its wild relative, has become man’s best friend.

The genome of the best friend

Science has found one more function for the dog: besides being man’s best friend, Canis familiaris may be an excellent genetic model for studying, and who knows, for finding, the molecular bases that led to the occurrence of a series of diseases in human beings, such as cancer and another 350 disorders present in mammals. In the long term, this may be the greatest contribution of the publication of the practically complete (99%) sequencing of the genome of the dog in the issue of December 8 last year of the British magazine, Nature. The main genetic material used in the work came from Tasha, a 12-year old boxer, who was selected by breeders’ associations and veterinary colleges for representing a very pure breed, with very homogeneous DNA and fewer differences amongst its pairs of chromosomes. This peculiarity made the task of sequencing the animal’s genome quicker. For being centered on the DNA of a bitch, the work does not bring information about the canine Y chromosome, present only in animals of the male sex.

Written by an international group of researchers, led by Kerstin Lindblad-Toh, from the Broad Institute, of the United States, the article in Nature informs that the 39 pairs of chromosomes of the dog’s genome have 2.4 billion pairs of nitrogenous bases, the chemical units that make up the DNA, and house 19,300 genes. Man has 23 pairs of chromosomes, about 3 billion base pairs and roughly 26 thousand genes. The smaller size of the canine DNA in relation to the DNA of our species is due to the existence of fewer repeated sequences in its genome. Besides Tasha’s genetic material, the study also contains data about the genome of another ten breeds of dogs and wild relatives of the dog (like the wolf and the fox), a kind of molecular information that will be very useful for establishing connections between the activation of genes and the appearance of specific physical traits and the development of the most common health problems in these animals. “Hundreds of years of careful crossbreeding have created the present-day breeds, which are an excellent genetic model for human diseases”, says Hans Ellegren, from the Evolutionary Biology Center of the University of Uppsala, in Sweden.

With the genetic sequencing of the dog in their hands, the researchers were able to make some comparisons with the genomes already mapped of other species of mammals. In a first study with this approach, they discovered that about 5% of the human genome seems to be conserved in the dog, and also in the mouse, an indication that these stretches must be essential for the three animals. The article on Tasha’s DNA is not the first effort to sequence the genome of the dog. In 2003, in a work published in the American magazine Science, another team of scientists mapped 75% of the genetic material of Shadow, the poodle of Craig Venter, the American scientist-businessman who set up a private program for sequencing the human genome. Both the canine genomes, Tasha’s and Shadow’s, are useful for science, but the boxer’s sequence is more complete and refined.