



INSIDE YOUR DOG'S MIND

By Ethan D. Mizer

Groundbreaking research into canine cognition begins to pull back the curtain on your dog's inner self.

We've all shared the dream of learning our dog's inner thoughts. Frequently, we'll speak up for our dogs, hazarding a guess about what they might be thinking, trying to illuminate their inner lives with our keen personal understanding of their behavior.

What seems a frown of a dog's brow might prompt, "Have you had a bad day, girl?" Or maybe we read their bark alert as an indication that a family member is home from work.

Sometimes our intuitions prove correct. But often we are wrong, and with each new canine cognition study, we're finding out that there's a lot more to our dogs' minds than we may think. We're learning about our own minds in the process.

Peeking into dogs' minds

The big — and obvious — problem about understanding our dogs' mental states is that we can't directly ask them what they're thinking. While dogs can understand some of what we say — and maybe more than we realize — they can't answer us in plain English. Because of this obstacle, we've had to focus on behavior to figure out what our dogs are thinking. However, as we learn more about dogs, we're frequently finding that we can't trust our intuitions.

"There are lots of very surprising findings out there," says Laurie Santos, professor in the department of psychology and founder of the Canine Cognition Center at Yale University in New Haven, Conn. "I love the clever work of (Barnard College Department of Psychology Professor) Alexandra Horowitz, showing that dogs who behave guiltily are more likely reacting to how people behave than their own sense of guilt. This finding is important to me because it shows our intuitions about what dogs know and feel are sometimes wrong. Sometimes we need an empirical study to really understand the truth about how dogs are behaving and what they're thinking."

Similarly, other researchers are learning surprising things about canine cognition. For example, many people assume that dogs don't have strong memory. Owners often equate training mistakes and apparent disinterest with a memory lapse in dogs. But that may not be the case at all.

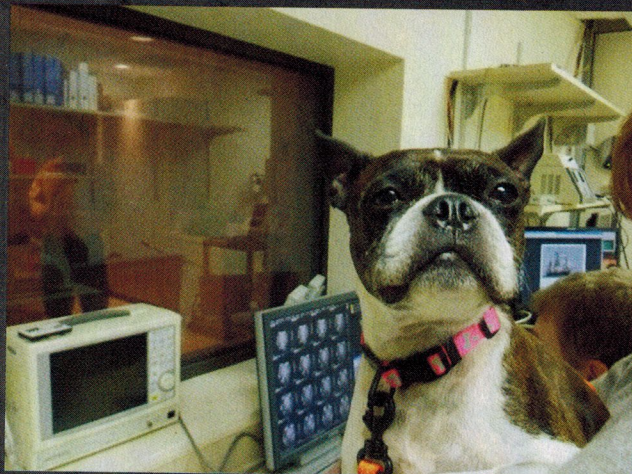
"There are many stories about the memory of dogs, but only a few experiments have been done," says Ádám Miklósi, head of the department of ethology at Eötvös Loránd University in Budapest, Hungary. "One recent result, obtained by my doctoral student Claudia Fugazza, is that dogs are able to remember a human action for more than 12 hours."

What we're finding out is that dogs are more complicated than we thought. We're not the only ones learning about another species' cognition, either. In Horowitz' study of canine play, she found something interesting.

"(I was observing) their use of attention in communicating while in ... rough-and-tumble play," says Horowitz, a professor and researcher in the department of psychology at Barnard College in New York City, and editor of the academic volume *Domestic Dog Cognition and Behavior* (Springer, 2014). "They turn out to use each other's attention in a very sophisticated way — and others' research has since confirmed that dogs are exceptionally good at understanding and manipulating human attention, too."

Many of us have probably suspected that dogs can anticipate and attempt to influence our behavior. Dogs are as interested in us as we are in them.

"It is fascinating to see how dogs can get along with people without having comparable physical and social



Tigger, a Boston Terrier and one of the pioneer canines in Emory University Professor Gregory Berns' functional magnetic resonance imaging training program, mugs in front of his brain scans.



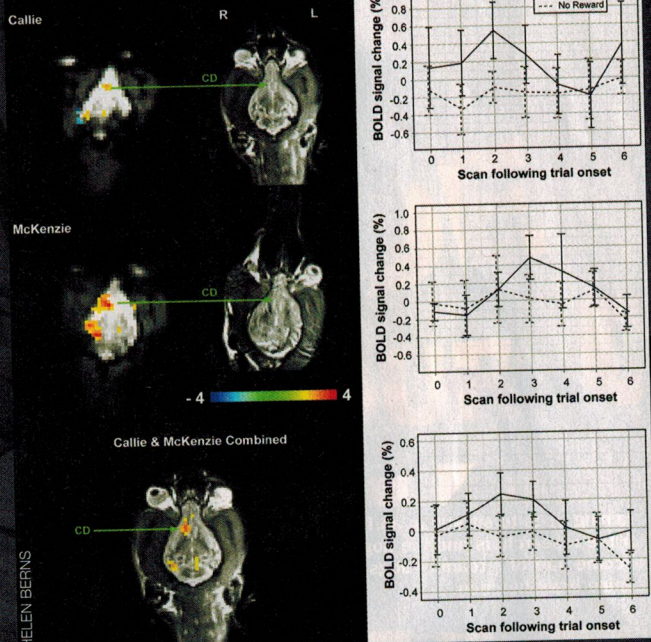
Training dogs to sit still in an fMRI scanner takes patience, both for the researchers and the dogs. Once they catch on, though, they become part of a team of dogs who are helping to reveal secrets of canine brain function.



Dogs trained to sit in fMRI machines have to remain nearly still for images to be useful for study.

PHOTOS BY HELEN BERNIS

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Here, two different dogs' caudate regions are lit up in their brain scans. We have the same region in our brains, and it appears that both dogs' and humans' caudate regions react similarly to stimuli.



As more dogs are trained to undergo fMRI procedures, the number and types of experiments researchers can initiate will continue to grow.

skills," Miklósi says. "The most important feature of their behavior is the strong attachment to their owner. This skill ensures that the dog is mostly in the vicinity of the human and has vast opportunity to learn (from) us."

We've had such a huge impact on canine evolution that we've seemingly altered dogs' cognitive abilities. "We know dogs have been selected not by people, but by natural selection, to prefer people," says professor and researcher Brian Hare, co-author of *The Genius of Dogs* (Penguin Group, 2013), and founder and director of the Duke Canine Cognition Center at Duke University in Durham, N.C. "That was incredibly advantageous to them. They have a psychology designed for that. They really are special that way. It isn't all nurture; it's both nature and nurture. ... It's a product of domestication."

This becomes evident when we compare dogs with related species. The more we observe dogs and wolves, the more we see that domestication and their social development have influenced behavioral decisions. "One such practical issue was how dogs get a hidden piece of food which they cannot reach," Miklósi says. "In this experiment, wolves tried everything to get closer to the food, but it was the dogs that found out rapidly, 'asking' (by looking at the human present in the experiment) the human for help is a much better idea. Of course, at the level of behavior control, this may not be too complicated, but it was intriguing to find out that our socialized wolves (kept in a manner similar to dogs from up to 4 months of age) did not stumble upon this possibility."

Revealing the canine brain

Though we've been limited in the past, our inability to directly observe the thought processes of dogs is changing, as a few innovative researchers pioneer ways to gather information on dogs' brains with a high degree of detail, just like in humans. Through advanced training methods, researchers have found a way to get dogs to hold still long enough to take pictures of their brains with functional magnetic resonance imaging scanners while they are still awake and responding to stimulus.

"The cool thing is, dogs are going to be leading the science," Hare says. "Dogs are going to leave other animals in the dust when it comes to studying these kinds of comparisons because they can be trained."

The best part about this new technique is that we can compare our own brain states to another species' brain states directly, through observing our brains and those of dogs under similar conditions.

Gregory Berns, lead researcher of the Dog Project at Emory University in Atlanta, has trained 18 dogs to sit almost completely still while in an fMRI machine.

"My background is using brain imaging to study the human brain, and I've focused on rewards systems and how that affects humans," Berns says. "About three years ago, I had the crazy idea to see if we could train a dog to sit in a brain scanner."

Not knowing if his plan would work, he sought out dog trainer Mark Spivak, founder of Comprehensive Pet Therapy in Atlanta. The team built an MRI simulator and slowly trained select dogs to sit very still for a period of time inside a noisy fMRI scanner. The team has already

produced some fascinating research.

"We recently published a study on how dog's brains react to the scent of their owner," Berns says. "We collected scents from people in a dog's household, as well as strange humans, strange dogs, and their own scent. The goal was to see how they're categorizing based on their social circle. We found that it was the familiar human scent that activated the caudate region of their brains. ... They clearly have recognition of these identities."

The caudate region can be found in both canine and human brains, and the research suggests that a dog's brain makes a positive association in a similar fashion to a human's brain (though the study did not make a direct comparison of a similar reaction in human subjects), Berns says.

Still learning

Berns isn't the only researcher making headway into fMRI studies of dogs' brains: Miklósi recently participated in publishing a paper where dogs' brain states were directly compared to human brain states. This is unprecedented, Hare says. The study looks at canine brains' response to vocal cues, comparing them to similar responses in human brains.

"Excitingly, the dog voice areas are ... located very similarly to human voice areas," Miklósi says. "We have known that voice areas exist in humans and macaques, but this is the first time (we've) found them in non-primates. This discovery pushes back the estimated evolutionary origin of the voice areas from 30 million years ago — the age of the last common ancestor of humans and macaques — to 100 million years ago — the age of the last common ancestor of humans and dogs."

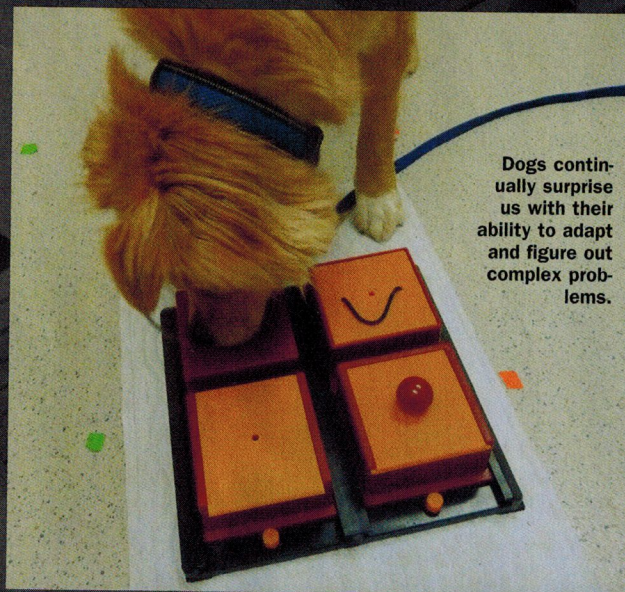
We've made huge leaps in understanding our dogs' minds. But we're really at the beginning of the process. With more study, new techniques, and scientific rigor, we have the potential to develop keen insights into another species' minds — and our own. **DF**

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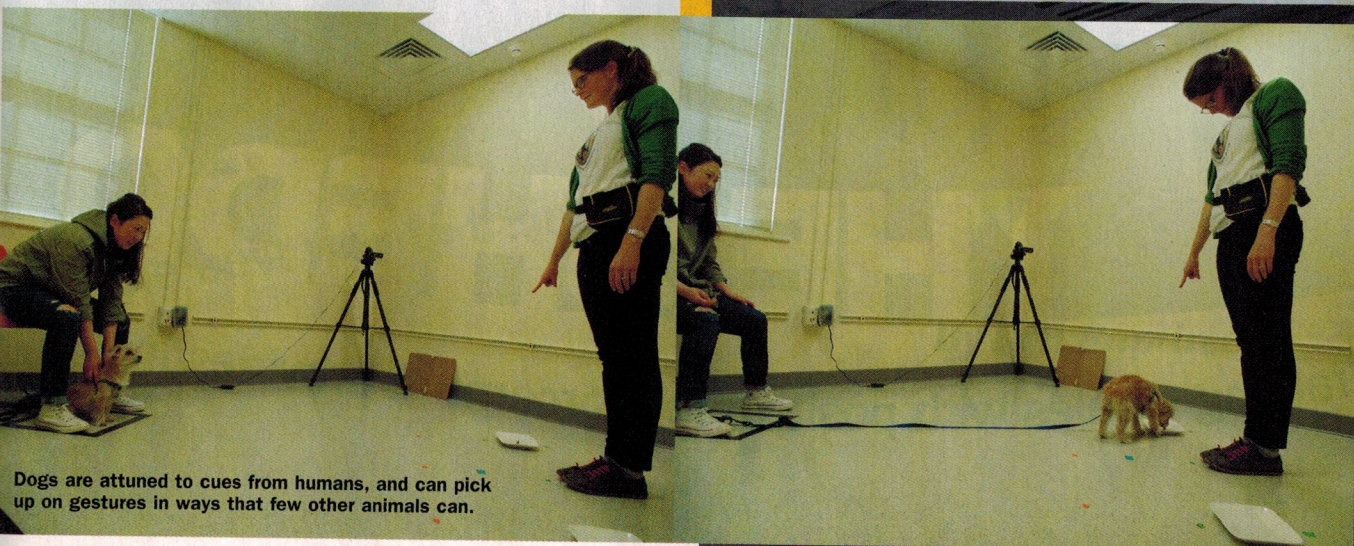


Observing canine behaviors and testing their cognitive abilities is central to the science of understanding dogs.

PHOTOS COURTESY LAURIE SANTOS



Dogs continually surprise us with their ability to adapt and figure out complex problems.



Dogs are attuned to cues from humans, and can pick up on gestures in ways that few other animals can.