

# Who's a clever boy then?

Thousand of years spent living among people have done remarkable things to dogs' intellects, says Kate Douglas



IF YOU have ever caught a dog stealing food, you will know the feeling: a sense that the dog knows it has done wrong and feels... well, guilty. Maybe that's pushing it – but try telling a dog owner that their pet cannot experience pain, excitement, love or other mental states we usually reserve for humans. You won't get very far.

Until a decade or so ago, scientists interested in animal behaviour would have dismissed these observations as sentimental anthropomorphising. They considered popular attitudes to pet dogs silly, and saw the animals themselves as little more than dumbed-down wolves. Above all, there was a widespread view that domesticated animals in general were "artificial" products of human breeding, irrelevant to anyone interested in studying real animal behaviour.

How times have changed. Last month more than 200 experts attended the first Canine Science Forum in Budapest, Hungary, where they discussed, among other things, what is going on inside the mind of a dog. While still some way from painting a full picture of the canine Umwelt, their work is making it clear that our inclination to invest dogs with human-like states of mind isn't as unscientific as it might appear. Dogs really do have some remarkable mental skills that allow them to thrive in their strange habitat – our world.

Domestic dogs evolved from grey wolves as recently as 10,000 years ago. Since then their brains have shrunk, so that a wolf-sized dog has a brain around 10 per cent smaller than its wild ancestor (see "Wild at heart", page 35). That was one reason why animal behaviourists felt dogs were merely simple-minded wolves. It has become clear, though, that despite the loss of brain volume, thousands of years spent evolving alongside humans have had a striking effect on dog cognition.

## Right from wrong

For one thing, researchers are increasingly convinced that dogs must possess some sense of right and wrong in order to negotiate the complex social world of people. A pioneer in this area is Marc Bekoff from the University of Colorado at Boulder, who has spent decades watching animals at play. He has championed the idea that in many social species, including dogs, one of the functions of rough-and-tumble play is to develop a rudimentary sense of morality (*New Scientist*, 13 July 2002, p 34).

The fact that play rarely escalates into full-blown fighting shows that animals abide by rules and expect others to do the same. In other words, they know right from wrong. Bekoff argues that this is a survival adaptation that allows animals to smoothly navigate other social interactions. ▶

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Friederike Range from the University of Vienna, Austria, takes the concept of dog morality even further. In a series of experiments, her team rewarded dogs with a food treat if they held up a paw. They found that when a lone dog was asked to give its paw but received no treat, it would persevere for the entire experiment, which lasted 30 repetitions. However, if they tested two dogs together but only rewarded one, the dog who missed out would make a big show of being denied its treat and stop cooperating after just a few rounds. "Dogs show a strong aversion to inequity," says Range. "I prefer not to call it a sense of fairness, but others might."

This is quite a claim: even the idea that primates respond to unfairness in a similar way to people is highly contested. So why would a dog need such a trait? Range points out that the concept of inequality is crucial for the stability of human societies; without it we would not punish freeloaders. Dogs probably evolved this response to help them negotiate our social world.

While the relationship between people and dogs may be built on fairness, it is mediated through effective communication. Perhaps that is why many researchers are fascinated by this aspect of canine cognition.

Dogs obviously do not have complex language, but they do bark. Barking is rare

## "Dogs show an aversion to inequality. Some might call it a sense of fairness"

among adult wild canids and feral dogs, suggesting that it evolved during domestication to allow dogs to communicate with us, says Péter Pongrácz from Eötvös Loránd University, Budapest.

Pongrácz and his colleagues have produced evidence that dog barks do indeed contain information that people can understand. In 2005 they found that even people who have never owned a dog can recognise the emotional "meaning" of barks produced in various situations, such as when playing, left alone and confronted by a stranger (*Journal of Comparative Psychology*, vol 119, p 136).

His team has now developed a computer program that can aggregate hundreds of barks recorded in various settings and boil them down to their basic acoustic ingredients. They found that each of the different types of bark has distinct patterns of frequency, tonality and pulsing, and that an artificial neural network can use these features to correctly identify a bark it has never encountered before. This is further evidence that barking conveys information about a dog's mental state (*Animal*

*Cognition*, vol 11, p 389). They also discovered that people can correctly identify aggregated barks as conveying happiness, loneliness or aggression. "Even children from the age of 6 who have never had a dog recognise these patterns," says Pongrácz.

Dogs are not just able to "speak" to us, they can also understand some aspects of human communication. At the forum in Budapest, Akiko Takaoka from Kyoto University in Japan described as-yet unpublished work that examined what is going on inside a dog's mind when it hears a stranger's voice. She played dogs a series of recordings of unfamiliar voices – both male and female – with each voice followed by a photo of a human face on a screen. If the gender of the face did not match that of the voice, the dogs stared longer, a sign that their expectations had been violated.

"This suggests that dogs generate an internal visual representation of a male or female correlated with the voice," says Takaoka. She suggests that this ability to infer information about a person from their voice alone might help dogs communicate with people. This is similar to what we do when we judge someone's age, sex or mood from the way they talk in order to gain information upon which to base our interactions.

Meanwhile, Juliane Kaminski at the University of Cambridge has been investigating how dogs interpret other forms of human communication. Experiments have already established that dogs can use human gestures such as pointing and gazing to find hidden food or toys (*Journal of Comparative Psychology*, vol 115, p 122). Kaminski wanted to know whether dogs simply learn to associate these kinds of gestures with a reward, or actually understand that these gestures are intended as a form of communication. This concept of "intentionality" is considered to be highly sophisticated.

To find out, she adapted a test originally done with 1-year-old children. A reward is placed under one of two containers, which are then moved around. The experimenter then makes either a communicative gesture, pointing, gazing or both, to indicate where the reward is, or makes a similar but non-communicative gesture, such as checking



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her watch or moving her head in its general direction. Just like babies, dogs usually choose correctly after deliberate pointing or gazing, but did no better than pure chance when she used a non-communicative action.

So when we point or look, dogs understand that we are trying to tell them something. "Domestication seems to have shaped dogs in a way which enables them to use these gestures from as early as six weeks," she says.

To what extent, though, can dogs understand referential communication such as icons and pictures? To find out, Kaminski recruited three dogs that could already identify dozens of toys by name and fetch them from another room on request.

## Copydogs

Kaminski wanted to know how far she could push the dogs towards using referential communication. When the dogs were shown a replica or miniature of a toy they returned with the correct original, showing that they understood some forms of iconic communication. In a paper to be published in the journal *Developmental Science*, she reports that one dog even managed to retrieve a toy after seeing a picture of it.

This observed behaviour puts dogs among the elite. Other animals, including chimps and dolphins, can be taught to do similar things, says Kaminski, but only after intensive training. Dogs of even average intelligence can be trained to do it more readily. Some, including the three in the experiment, learn it spontaneously.

"Dogs identify human communicative behaviours in ways similar to human infants," says József Topál from the Hungarian

Academy of Sciences. In fact, he believes the similarities between dogs and infants do not end there, arguing that evolution has left dogs with a mind primed for social interactions in much the same way as our own.

The first step in human socialisation is for a baby to become attached to its carer, and we have known for some time that dogs attach to their owners in the same way. For example, dogs will explore an unfamiliar room if their owner is present, but become anxious and timid if the owner leaves – a pattern of behaviour that is also seen with babies and their primary carers.

Topál has now moved on to the next stage of human socialisation, which involves a specialised form of learning called pedagogy. While animals, including chimps, learn by emulation – watching others complete a task and then using a mixture of copying and extemporising to achieve the same result – we are uniquely capable of exact imitation. This is the defining feature of pedagogy, and it occurs spontaneously between infants and their carers (*New Scientist*, 1 April 2006, p 42).

Pedagogy begins with the teacher using eye contact, gesture and vocalisation to direct the attention of the learner. Dogs, uniquely among animals, do the same. "Dogs' performance matches children's," says Topál. He believes that these attention cues trigger a receptive attitude in dogs that is comparable to pedagogical learning in humans.

This is backed up in experiments by Ludwig Huber and colleagues at the University of Vienna in Austria. They based their work on a classic pedagogy experiment in which an instructor demonstrates to a toddler how to turn off a light using her forehead. In one

version of the demonstration, the instructor has her hands clearly visible on the table. In the second version, her upper body is wrapped in a shawl so that she can't use her hands. When invited to turn the light off for themselves, toddlers who were shown the first version use their heads, but those shown the second use their hands. The interpretation is that the first group conclude that there must be a good but non-obvious reason for using the forehead method, as otherwise the instructor would have used her hands.

Huber has found that dogs do exactly the same thing. In an experiment where dogs had to pull a lever to obtain a reward, the default choice was to use their mouths. They would do this even after a demonstrator dog had used its paw – but only if the demonstrator had a ball in its mouth. If it used its paw when it could have pulled with its mouth, then they copied the action exactly.

Findings like these are leading some researchers to propose that dogs have at least a rudimentary form of "theory of mind", the mental capacity that enables us to understand the desires, motivations and intentions of others. It is generally accepted that a few other animals, including great apes, are capable of this mind reading to some extent, but it is nevertheless a quality reserved for only the most intelligent of species. So that puts dogs in intellectually elevated circles.

Not everyone agrees, however. Alexandra Horowitz from Barnard College in New York prefers the term "theory of behaviour" to describe dogs' apparent insight. "I think there is a massive territory between a theory of mind and a theory of behaviour," she says. Her own recent study illustrates the point: when dogs play together, they use appropriate signals for grabbing attention or signalling the desire to play depending on their playmate's apparent level of attention, such as whether it is facing them or side-on (*Animal Cognition*, DOI: 10.1007/s10071-008-0175-y). That could be interpreted as mind reading, she admits, but a simpler explanation is that dogs are reading body language and reacting in stereotyped ways.

Such caution is understandable. After all, the study of dog psychology began with Pavlov, and even a few years ago the notion of dogs having a theory of mind would have been dismissed out of hand. Nevertheless, as we delve deeper, the inner world of dogs is starting to look awfully familiar. Maybe we should be the ones feeling guilty for not realising it sooner. ●

## Wild at heart

Genetic evidence tells us that domestic dogs are descended from grey wolves, with dogs being biologically classified as a subspecies of *Canis lupus*. Put a wolf into the alien environment of a human home, though, and it becomes very clear that domestication has taken dogs a long way from their wild roots.

The traits that we prize most in dogs are simply not there in wolves: they are hard to train,

wary of new experiences, scared of strangers and unpredictably aggressive. They also have some rather antisocial habits. For example, they scent-mark a lot, like to escape and would probably trash your home. On the upside, wolves don't bark – although that probably limits their ability to communicate with people (see main story). Instead, they howl.

Owning a pet wolf is increasingly fashionable and there

are plenty of websites offering tips to would-be wolf tamers. However, the best advice, according to canine behaviour expert James Serpell from the University of Pennsylvania, is don't. "Wolves do not make ideal house pets," he says. That might also help to explain why our ancestors apparently only domesticated wolves once, despite the two species living together over large swathes of the globe for millennia.