

## The Human–Canine Bond: The Evolution of Unique Social Skills

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Over the course of history, humans have, for a variety of reasons, domesticated everything from cats and dogs to snakes and horses. Yet none of them receive the attention, care and love that dogs do. Why is this? What makes dogs man’s best friend? The answer seems to lie in the long relationship between the two species. Domestic dogs are remarkably skilled at reading human social and communicative behavior, perhaps even more so than our nearest primate relatives. Those specialized social skills are the foundation of the inimitable relationship between humans and dogs. Dogs are our hunting partners, guards and cherished family companions, and the specialized social skills they possess make them perfectly suited for filling these roles.

Research conducted at the Max Planck Institute for Evolutionary Anthropology in Germany has concluded that these unusual social skills have a heritable component, initially evolved during domestication as a result of selection on systems mediating fear and aggression towards humans (Hare & Tomasello, 2005). Differences in chimpanzee and human temperament suggest that a similar process may have led to the evolution of the distinguishing social skills of our own species. This essay will explore the evolution of the unique social-communicative skills of dogs, suggesting that humans and dogs were subject to a convergent social evolution. It will examine the theory that dogs and humans have been subject to similar selective pressures, and discuss how this has impacted the development of the relationship between humans and dogs.

In 1998, Hungarian researchers studied the performance of domestic dogs during an experiment in which they hid a piece of food or an attractive object in one of several opaque containers. They then looked at or pointed to

that location in an attempt to help the dog find the hidden object. In initial studies, they set up situations in which food was hidden in one of several locations and then a cue was given to indicate where the food was hidden. Across all the studies, the results showed that the dogs were able to use several different behaviors to locate the hidden food at above chance levels: a human pointing to the target location; a human gazing at the target location; a human bowing or nodding to the target location; and a human placing a marker in front of the target location (a totally novel communicative cue) (Soproni, Miklosi, Csanyi, & Topal, 2001). The dogs were even able to do the task correctly when the human walked towards the wrong container while pointing in the opposite direction to the correct container. In addition, dogs performed equally well whether cues were provided by conspecifics or humans. “In all of these cases, the dogs used the behaviors effectively from their very first trials, showing that they already possessed the required skills before the experiment” (Hare & Tomasello, 2005).

In subsequent research, a comparison between chimpanzees and dogs, subjects of both species were given the “novel block” cue, where the human gets the animal’s attention and places a block on the target container. The dogs performed much better than the chimpanzees tested (Hare, 2002). In other studies, dogs have performed well in this task even when they only see the block placed initially and it is removed before they make their choice, demonstrating that they are not just attracted to the block itself. This is significant because the dogs’ ability to interpret human social and communicative behavior appears to be more flexible than that of other animals more closely related to humans phylogenetically, such as chimpanzees, bonobos and other great apes (Hare & Tomasello, 2005). With respect to gaze cues, dogs only use a

human head and eye direction cue to locate hidden food if the person is gazing directly at one of the two possible hiding locations; they ignore a human's gaze if the person stares into space above the correct hiding location. This suggests that dogs discriminate human communicative behaviors from other behaviors, in ways similar to human infants (Hare & Tomasello, 2005).

What is interesting about these findings is that dogs, relative to other animals, do not seem to show special flexibility in other nonsocial areas. When dogs are directly compared with primates in their ability to do such things as make inferences about the location of hidden food based on nonsocial cues, they fail miserably in comparison with nonhuman apes. Dogs also fail means–end tasks that require them to avoid pulling a string that is not connected to food in favor of one that is connected to the food, a task that most primates solve easily (Hare & Tomasello, 2005). It seems, therefore, that the skills of dogs represent a specifically social specialization.

The first and most common hypothesis regarding the origin of the specialized social skills of domestic dogs is that dogs grow up with humans and learn from them, causing an “enculturation” similar to that proposed to explain the unusual cognitive abilities of apes raised by humans. This theory implies that the ability to read human social behavior should develop over a dog's lifetime and should vary depending upon the amount of exposure a dog has had to humans. However, a cross-sectional comparison of puppies found that different age groups did not differ in their ability to use a human pointing or gaze cue; even puppies as young as 9 weeks old were nearly perfect in basic tests. In addition, when a group of puppies in an obedience class was compared with a group of litter-reared puppies (with little exposure to humans) in their ability to use the same pointing and gazing cues, both groups were equally skilled at using the cues (Hare & Tomasello, 2005). These findings did not support the hypothesis that dogs need unusual amounts of exposure to humans to learn to read human social and communicative behavior.

A second hypothesis suggests that domestic dogs inherited their specialized social skills through common descent with the wolf. However, two independent studies have found that wolves reared by humans are not as skilled as dogs in using human social behaviors to find hidden food. In addition, when human-reared dogs and wolves were both presented with an impossible task of opening a locked box with food inside, the dogs almost immediately gave up and directed their gaze alternately between the human and the box, whereas wolves continued to try to solve the task on their own until the test ended (Miklosi, 2003). Studies comparing wolves and dogs on simple nonsocial problem solving or memory tasks typically find that wolves perform as well as, if not better than, dogs (Hare & Tomasello, 2005). Overall, these comparisons do not support the hypothesis that dogs inherited their social skills directly from wolves.

The third hypothesis is that the unique social skills of dogs evolved during the process of domestication. In 1959, Dr. Dmitry Belyaev and his colleagues began one of the longest running experiments in history with the goal of studying the behavioral genetics of domestication. An experimental population of foxes was selectively bred based on a single criterion, their tendency to approach humans fearlessly and nonaggressively. When fox kits from this domesticated population were compared with age-matched dog puppies on the basic pointing and gaze-following tests, the foxes were as skilled as the dogs in using the human social cues. When compared with a population of control foxes that were bred randomly with respect to their approach towards humans, the domestic foxes were more skilled than the controls at using human social cues. Crucially, neither population of foxes was bred or tested for their ability to use human communicative gestures or behaviors. Therefore, these findings confirm the likelihood that dogs' unusual ability to read human social-communicative behaviors evolved during the process of domestication, and in addition identify a selective pressure that is likely to have played a role in driving the evolution: selection against fear and aggression towards humans (Hare & Tomasello, 2005).

Such selection probably occurred as wolves began exploiting the niche created by refuse in and around human settlements. For dogs, understanding the communicative cues of humans was presumably an important aspect, either direct or indirect, of the domestication process (Brauer, Kaminski, Riedel, Call, & Tomasello, 2006).

Once the initial evolution occurred so that dogs were motivated to apply these inherited cognitive abilities to solve a new set of social problems involving humans, the variance in these cognitive abilities might have come under direct selection. When dogs evolved constraints on fear and aggression, cooperation with people became possible. Consequently, among the cooperator dogs were some that were also better communicators. They got the jobs of helping people with herding or hunting. Therefore, a pleasant temperament may have been the prerequisite for gaining the survival advantages offered by communication skills (Walton, 2002a). There is little evidence to support the second selection event, but it proposes an interesting theory that deserves further investigation.

Recent findings propose that the unusual social skills of dogs arose as a result of domestication and represent a case of convergent evolution with humans. Research suggests that human-like social intelligence could have initially evolved, not as an adaptation, but rather as a byproduct of selection on seemingly unrelated social-emotional systems (Hare & Tomasello, 2005). Support for the hypothesis that changes in temperament allowed for further social-cognitive evolution in humans comes from studies of chimpanzee cooperation. The basic finding is that cooperation among chimpanzees is highly constrained by levels of interindividual tolerance, probably controlled by systems mediating fear and aggression (Hare & Tomasello, 2005). For example, without any training, chimpanzees will cooperate to pull ropes together to retrieve a heavy box of food, but they are only willing to do this if the food is sharable, the partners are out of each others' reach, and the partners have shared food

previously in a similar context. If these criteria are not met, the chimpanzees will not cooperate. It seems that unless the conditions are right subordinate chimpanzees are not willing to risk being attacked by intolerant dominants and dominants are unable to control their aggression towards subordinates trying to obtain food, even if it means they will receive no food at all.

Furthermore, chimpanzees perform better in tasks when competing than when cooperating. "In the standard object choice task, this finding was robust regardless whether the competitor was a human or another chimpanzee" (Hare & Tomasello, 2004). In addition, chimpanzees exploit the social behaviors of others when competing for food. Chimpanzees commence food-finding behavior when they see a human who has previously established a competitive relationship with them, reaching unsuccessfully toward a potential food location in an apparent attempt to obtain hidden food (Hare & Tomasello, 2004). However, if the same chimpanzee sees a helpful human pointing to the hidden location, they do not use the gesture to locate food (Hare & Tomasello, 2005). This complexity for primates is something of a mystery if you consider that chimpanzees, in particular, seem to have many of the requisite skills to solve such a problem, as demonstrated in other cognitive tasks. For example, in several other situations, chimpanzees appear to be capable of assessing what another individual can see, including following their gaze direction to objects hidden from their immediate view (Hare, 2006). Therefore, it could be that chimpanzees do not demonstrate human-like skills in using communicative gestures because they lack the human-like temperament for sharing information.

Research with chimpanzees suggests that a prerequisite for flexible forms of human cooperation and communication is a human-like temperament (Hare & Tomasello, 2005). In fact, the evolution of human-like temperament might have preceded the evolution of more complex forms of human cognition: "It is only after the human temperament evolved that variation in more complex forms of communicative and cooperative behaviors could

have been shaped by evolution into the unique forms of cooperative cognition present in our species today” (Hare & Tomasello, 2005). Following this line of reasoning, one might entertain the hypothesis that an important first step in the evolution of modern human societies was a kind of self-domestication (selection on systems controlling emotional reactivity) in which human-like temperament was selected (individuals within a social group either killed or ostracized those who were overaggressive). Thus, like domestic dogs, this selection for tamer emotional reactivity put our hominid ancestors in a new adaptive space within which modern human-like forms of social interaction and communication could be selected for (Hare & Tomasello, 2005).

Critics of this hypothesis question whether domestication alone can account for the social skills observed in dogs. They argue that, although domestication is often viewed as directional selection against aggression and fear, the actual process was likely to be influenced by the type of interaction between humans and the species in question. In addition, they contend that any emergent social skills towards humans in domesticated animals are probably a function of the social behavior exhibited by the wild ancestor. This is clearly seen in the divergent performances of domesticated animals during the “cueing task.” On the basis of observing human communicative cues, goats show some evidence of finding hidden food, but horses seem to perform poorly (Miklosi & Topal, 2005). Research conducted with pet dogs and cats reared in the same human families also shows that, although both species were equally skillful in using human pointing cues, cats were less likely than dogs to look towards a human when faced with an unsolvable situation (Miklosi & Topal, 2005). Critics suggest that the reduction in emotional reactivity alone is not sufficient to explain dog behavior and we must look for behavioral changes that might have emerged as a result of selection in social domains other than aggression and fear.

Miklosi and Topal (2005) also point out a methodological position to be considered that makes the fox experiment difficult to interpret.

They argue that it is very likely that the foxes have inadvertently been selected for basically the same behavior as they actually showed during the cueing test, approaching humans or hands providing food. “Namely, when the experimenter extended his arm to the bowl containing hidden food in the cueing test, performance of tamed foxes can be attributed to their selected preference for approaching humans or parts of the human body. As such cueing was also relatively easy for socialized wolves to rely on, without further control experiments the relevance of the fox study on the origin of social skills in dogs is disputable” (Miklosi & Topal, 2005).

Critics also advise that information acquired from experimental object-choice and gaze tests with primates should be reviewed with caution. Researchers at the University of Louisiana at Lafayette attempted to assess the influence of different procedures on chimpanzees’ performance in the object-choice tasks. Five chimpanzees were tested using three experimenter-given cues to food location: gazing, glancing and pointing. In one procedure, the subjects entered the test unit and approached the experimenter on each trial (LEAVE Method). In the other procedure, the subjects stayed in the test unit throughout a session, witnessed the hiding process, and waited for 10 seconds, during which the cue was provided (STAY Method) (Barth, Reaux, & Povinelli, 2005). The subjects scored at high levels far exceeding chance in response to the gaze cue only when they approached the experimenter for each trial (Barth et al., 2005). They performed at chance levels when they stayed inside the test unit throughout the session. They scored at chance levels on all other cues irrespective of the procedure (Barth et al., 2005).

These findings imply that chimpanzees can immediately exploit social gaze cues, and previous conflicting findings were likely due to the different meta-procedures that were used (Barth et al., 2005). The critics argue that greater attention should be devoted to the exact methods used, and that the results of this research should be extended to nonprimate species as well. Thus, it would be crucial to reevaluate the effect of

different methods on the dogs' performance (Barth et al., 2005). In the studies with dogs, the subjects typically approach the experimenter from a distance (LEAVE Method), and it would be interesting to see if they perform equally as well when sitting in front of the experimenter (STAY Method).

In order to fully understand the impact of selection for tameness on the ability to interpret social signals, more research must be conducted. Given that this area of research is relatively new, the theories surrounding the origins of the unique social skills of dogs are in their infancy. Oddly enough, the strength of the human–canine bond may be just the reason why more research in this field is not ongoing. There are more studies on the call of the red winged blackbird than on what different dog barks mean, and more data on the head movements of some lizards than on what a dog's tail wagging means (Walton, 2002b). There is speculation that the dearth of details on humans' most loyal companion might have something to do with scientists distancing themselves from anything that goes beyond cold, hard facts: "Science has always been uncomfortable with emotions, so there's a real bias against studying domestic

animals; especially canines that may sleep in our beds and eat off our plates and otherwise get spoiled" (Walton, 2002b).

The most recent research that has been conducted on the origins of the unique social skills of dogs and humans argues that a convergent evolution has occurred. It seems that domestic dogs and humans have evolved similar social-communicative skills. In both cases, these abilities seem to have been adapted for certain kinds of communicative interactions with human beings. Thus, the coevolution of dogs with humans must have selected for a set of cognitive abilities between the two that makes the bond between humans and dogs unique. The domestic dog's unique ability to communicate improves the relationship between dogs and humans and lends insight into why both dogs and humans feel a special connection to one another. Additional explorations into the ways in which dogs do and do not interact with humans, and how they evolved their special social skills, will provide us with an exciting opportunity to gain further insight into the developments leading to human-style cooperative actions and communication.

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