

**A Dog's Best Friend:**  
**The Human Influence on the Evolution and Behavior of**  
***Canis familiaris***

Dale A Zaborowski  
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The dog is a common fixture in our homes and part of our families. This relationship between humans and dogs has been in place for thousands of years. Working dogs have had important roles in our lives and in some cases, still do. The variability of dog behavior has led to numerous breeds of dogs that perform different tasks and functions. There are many questions as to how it all began. Unlike other domesticated animals, the bond between the human and the dog is unique. No other animal has been as versatile and at the same time as loyal of a companion as the dog has been. My own lifetime has been spent in the company of dogs that were not only pets, but working companions whose behavior has been sculpted over time to become a valuable tool in special purposes. What is the origin of the dog? What were the ultimate causes of the behaviors that bonded the dog to humans? How did humans influence the evolution of the dog? I hope to suggest some answers to those questions here.

In searching for the ultimate causes of the behaviors, it is difficult to ignore the proximate causes of behavior in the “proto” dogs, as well as their physiology, morphology and ecology because some proximate mechanisms led to ultimate changes in morphology and behavior. This is another example of behavior of an animal being the sum of all its biological parts. In the past decade, a renewed interest has been seen in the evolution of *Canis familiaris*, most notably, in the use of modern biochemical techniques

in determining the relationship of dogs to other canids. Most of the work has been focused on the evolution of the dog, with little mention of the behavior of dogs and their ancestors. I put forth the idea, along with a few authors, that the behavior is the reason for the eventual evolution of dogs from the wolves and that humans influenced the evolution of the dog in an indirect way.

In North America about 37 million years ago, the evolution of the dog begins to take shape. A distinct group of carnivores began to appear. These predators had distinctive pairs of shearing teeth and ran down their prey. This group of *Caninae* diverged into as many as 18 different species by the late Pleistocene. As the climate cooled, all but one of these followed their large prey into extinction (Lange, 2002). The lone survivor was the fox-sized *Eucyon*. With less competition, *Eucyon* began to increase its range and eventually crossed to the Asian continent. From there it is believed that all modern canines evolved. There are forty-one extant species of canines today and an additional one, *Dusicyon australis*, the Falkland Island wolf, which became extinct about 1880. These are dogs, wolves, jackals, foxes, zorros, and coyotes. Of all of these, the gray wolf, *Canis lupus*, seems to be the most logical ancestor to the dog.

The gray wolf spread throughout all of Europe and Asia. By 800,000 years ago, *C. lupus* crossed into Arctic North America, as did foxes and the ancestors of jackal, coyotes and *Cuons*, expanding its range to the rest of the continent and into Central America about 100,000 y.a. Eventually, becoming the most widely distributed species of the “wild dogs.” Unjustified fear caused the ever-growing population of humans to wipe out wolves in many areas of its range but it is still the one of the most widely distributed of the mammals. As with other large canids, *C. lupus* generally lives in packs varying in

size. The pack size is dependent on food sources. In areas where the prey is large, the pack size will also be larger. Where small prey is the mainstay, packs seldom exist or are loosely maintained. The need for the pack is diminished as food becomes easier to acquire. The same holds true for the range of the pack or the individual. Wolf ranges have been documented as small as 35 square miles to as large as 3600 square miles. Canines do not possess a lethal bite (Alberton, 1994) so they must rely on the combined physical strength of the pack to bring down large prey. Wolves rely on stealth as a hunting strategy. Most of their prey can outrun them. So again, the pack has an advantage in ambushing unsuspecting large prey like deer, elk, and moose or by cooperative hunting. All wild dogs are opportunistic feeders, being willing to eat not just large game, but birds, reptiles, rodents, even fish, insects, carrion, fruit and plants.

Within the pack, communication is done in many ways. Body language, smells and vocalizations are used in a variety of ways. Scent is used as a way of identifying individuals and for territorial marking. This is also common in other canids like the foxes. Facial movements also are used as a form of close communication to signal especially within the pack. Vocalizations are used as a way of unifying the pack. Howling is done to “stay in touch” with the other members of the pack when they are not within visual contact. All members of the pack usually join it, and eventually other packs join in, one by one, which is a way of defining territory amongst the packs. This is not as organized as the method used by the dhole, an Asian wild dog that uses a whistling howl to keep up with others as they pursue prey in the brush, as a way of controlling and organizing the hunt.

Within the wolf pack, there is a breeding social hierarchy. The dominant male and female usually is the only breeding pair in the pack. The subordinate females will often have “phantom pregnancies” where they lactate, acting as surrogate mothers to the offspring of the dominant pair. The pack bonds are not rigid. Strong bonds occur in the winter, when breeding takes place so that birth is timed with the spring and early summer. Winter is a more dangerous time. Food is harder to come by, so the pack is more important at that time. In the spring and summer, the pack does not always stay together all the time and subordinate members of the pack may breed on their own. Lone male wolves may have more than one breeding partner during a year.

It has long been thought that dogs evolved from wolves. Darwin wondered whether a species with such a high variability could have a common origin (Scott, 1965). He and others speculated that dogs had several origins and contributions not only from wolves, but also the coyote, *C. latrans* and the jackal, *C. aureus*. Robert K. Wayne, states “in the past, the evolutionary relationships of canids have been studied by morphological approaches, but parallel changes in several evolutionary lineages can make inferences uncertain” (Derr, 2000). He has been using molecular and biochemical techniques to study the relationships of canids in several different studies. He and his colleagues found that the domestic dog varies by only 0.2% from the wolf in comparison using mitochondrial DNA (Vila et al, 1997). However, hybridization occurs between wolves and coyotes, especially where ranges overlap. This has created an issue on the endangered red wolf, *Canis rufus* which from the same type of analysis appears to be a hybrid of the wolf and coyote, which is thought to have intermingled with both species at the overlapping edges of their range (Wayne, 1993). That creates an issue over its status

as an endangered species. Coyotes and jackals have been experimentally bred successfully, also. It is also not uncommon for domestic dogs to breed with both wolves and coyotes, usually it is a male of the wild species mating with a female dog (Alderton, 1994). Given all of this evidence, the picture remains unclear.

All of that considered, the behavior of the wolf tends to emerge as the deciding factor in the mystery. Wolves and early nomadic humans coexisted on the same ranges, with social structures, pursuing the same large animals as prey. That would put wolves and humans in a situation where they encountered each other often, even competing against each other. The fossil record indicates a multiple origin of the dog, all around the same time as humans began more permanent settlements with the development of agriculture. There are 2 general hypotheses as to how the domestication of the dog began. The first, and probably the oldest, is the romantic idea that an ancient hunter was foraging and found a wolf puppy, took it back to the cave, giving rise to the whole *C. familiaris* line. That simplified version has been seriously studied and there are those who suggest that wolf cubs could have been taken for food at first and then as companions trained to benefit humans. The other hypothesis, which seems more likely, is that lone wolves or small groups, possibly ousted individuals, began to scavenge around human encampments, making use of the scraps of meat leftover from kills. These lone scavengers could have easily become regular visitors to the camps, becoming less fearful of humans. Canines are naturally inquisitive (Alderton, 1994) and would easily exploit a new food source. The humans could have also become more familiar with the wolves, even offering food to a frequent visitor on occasion. The camp began to benefit from the presence of the wolf. The keen senses of the wolf could alert the camp of

approaching danger, chase off other scavengers, rodents, etc. The male “associating” wolf could also sneak an occasional breeding with a female of a pack, not having to challenge the alpha for dominance in the pack. A female associating with humans might have started her young around humans, making the young even less fearful of the clan, allowing for a closer bond between the two species. Her utilization of an easy food-source would have helped in caring for her offspring. The human clan would have replaced the wolf pack, with the wolves treating the humans as higher pack members, and the human social structure was probably similar to that of the wolf pack. Those individuals associating with humans had an adaptive advantage, having breeding opportunities they would otherwise not have.

The question that arises is how did the morphological differences between the dog and the gray wolf occur? With over 300 different dog breeds of today and all with distinct characteristics, most of which are not found in wolves, how did the characteristics of the dog derive from wolves? The answer may again be linked to behavior. The wolves that began to associate with humans would eventually exhibit a certain degree of “tameness.” Those proto-dogs that were found around human encampments would have to be “friendly” or they would be driven off or even destroyed. The limited fossil record shows that early “dogs” did not change in appearance until about 15,000 years ago. A collection of fossils found in the Beaverhead Mountains of Idaho had a beagle-sized dog and a retriever-sized dog. The find was dated to 9000 ya. There were 20 different mutations that had to occur if this was the result of gradual natural selection. A more likely explanation is that the changes in morphology and many of the behaviors of the dog are caused by pedomorphosis, the retention of juvenile

characteristics into the adult body. Modern dogs display behaviors that are found in juvenile wolves. “Growing up” is not a matter of growing bigger but rather remodeling (Enlow, 1975). Development of a wolf or a dog has various stages where certain behaviors appear. Those behaviors are not found in adults. Some examples are; dependence, care solicitation, submissiveness and lack of fear. These traits are common among the behaviors of modern *Canis familiaris*. Trainability and tameness are essentially the same thing. Those traits are the characteristics of the adolescent and juvenile wolf (Serpell, 1994). Along with the behavioral traits, the morphology of the early dogs began to change. Part of the reason was pedomorphosis as already mentioned. A study by D. K. Belyaev over a 40-year period used foxes from a fur farm. He started with a stock of foxes and began to select for tameness. After 8 to 10 generations, some unique changes began to occur. Piebald coloration began to appear in individuals who display tameness, and even solicited attention. Tail wagging, play and other typical dog behaviors began to emerge. Other physical differences were also seen like lopped-ears, shorter muzzles, broader skulls and curly tails. These same changes are suspected in other domestic animals such as cattle, most notably piebald coloration (Serpell, 1995). The same changes probably occurred in early dogs.

Other factors may have contributed to the morphological changes as well. The dogs of most modern hunter-gathering societies like Australian aborigines and the Kung Bushmen of Africa are often undernourished. This might suggest a reason for the smaller size of dogs compared to wolves. A small size would have an advantage if food were not plentiful. Natural selection would favor a smaller dog. The diminution of size in the early dogs was also a response to the changed ecological regime of the domestic state.



The relief of selective pressures associated with domestication set in motion a cyclical reaction of accelerated maturation, increased reproductive capacity with a tendency for litter sizes to be larger, and shortened generation time (Tchernov and Horwitz, 1991, quoted in Serpell). The result would be smaller offspring of younger parents. The smaller size created new differences in tooth number and facial displacement, further separating the dog from the wolf.

Artificial selection certainly played a role in the development of today's dog, but probably did not occur until much latter in the history of the dog. The idea that early humans took wolf cubs and began creating working stock does not seem logical. It had to be later on as farming and hunting practices became more sophisticated that selecting for working behaviors was the goal. Physical appearance of dog breeds was not a factor until about 100 years ago as show breeding came to be. Dogs were bred for specific tasks, hunting, herding and guarding. The selection for traits is really based on behaviors that wolves possess. Many of the breeds of dogs developed in the northern areas maintain a more lupine appearance, while smaller, slender dogs appear in warmer, harsher climates (Alderton, 1994). Each type of dog breed has a story of development, mostly within the last 300 years. The current breeds of sporting dogs for example, the spaniels, pointers and retrievers, were developed after the invention of the shotgun. Toy breeds are an attempt to breed puppy-like adults. Still, the majority of dogs are for the same purposes as their original benefit to early humans, hunting, herding, guarding and companionship.

In the last 40 years or so, new functions have been found for dogs. Bomb-sniffing dogs, rescue dogs, the U.S. Department of Agriculture's Beagle Corps, which sniffs for

smuggled fruit, vegetables and food, and drug-sniffing dogs utilize a superior sense of smell. That sense of smell is unusual given that the wolf is mostly an animal of the open countryside (Alderton, 1994). Some dogs are now used to detect bladder cancer in urine. Other uses utilize the dog's trainability like guide dogs for the blind and helper dogs for the handicapped, training dogs to perform tasks unique to their behavioral history. As long as dogs keep hanging around us, we will keep finding other ways that they can help us.

It might be more accurate for the domestic dog to be called *Canis lupus familiaris*, because the dog is simply a modified wolf, even though coyote and jackal may have been introduced into the line at different times. Humans helped to shape the early dog, not by selective breeding as in later times, but by changes in selective pressures created by human settlements. The behavior of wolves led to the evolution of the dog. Dogs display traits of adolescents and juvenile wolves and the selective pressures made those traits more favorable. With the expression of those behavioral traits, certain morphological changes occurred. It was well after this pattern was established when humans began to selectively breed dogs for specific purposes.

## Literature Cited:

Alderton, David. 1994, *Foxes, Wolves and Wild Dogs of the World*. Facts on File, New York.

Coppinger, R.P. and C. K. Smith, 1983. The Domestication of Evolution. *Environ. Conserv.* 10, pp.283-292

Derr, Mark 2000, Dogs and Humans are Seen as Partners in Evolution, *New York Times Online*. [Http://Evolution-dogs-humans-nyt.htm](http://Evolution-dogs-humans-nyt.htm).

Gradin, Temple, Editor, 1998 *Genetics and the behavior of Domestic Animals*. Academic Press, San Diego, CA

Lange, Karen E. 2002, Wolf to Woof, *National Geographic*, January pp. 2-11.

Scott, John Paul and John L. Fuller. 1965, *Genetics and the Social Behavior of the Dog: The Classic Study*. University of Chicago Press, Chicago.

Vila, Caris, Peter Savolainen, Jesus E. Maldonado, Isabel R. Amorim, John E. Rice, Rodney L. Honeycutt, Keith H. Crandall, Joakim Lundeberg, Robert K. Wayne. 1997, Multiple and Ancient Origins of the Domestic Dog. *Science*, vol. 276, 13 June.

Wayne, Robert K. 1993, Molecular Evolution of the Dog Family, *Trends in Genetics*, pp. 218-224