Animal Evolution: Foxy Friends

Red foxes that have been selected since 1959 for tameness to humans show some of the sociocognitive abilities of domestic dogs, raising questions for theories of the evolution of cognition.

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How would you go about domesticating an animal? Domestication lies at the end of a scale of changing relationships between human and animal that begins with ‘habituation’, the acceptance by a wild animal of the close presence of humans. Habituation allows scientists to collect behavioral data without materially affecting their subjects, and can generally be achieved by patient and neutral following. Beyond that comes ‘taming’, where the animal comes to allow a human to look after and safely control it, exemplified by the capture and training of wild elephants for logging and transport, or wild parrots for amusement. Adults can be tamed, but young animals tame more easily, so captive-breeding is often employed — but, crucially, the breeding is not selective. If, instead, selective breeding is employed to modify the animal into something more amenable to human use, then we have a domestic animal.

It would seem, then, that the answer is simple: to domesticate an animal, selectively breed individuals to emphasize traits that are desired, but missing or faint even in tame individuals. For a food supply, select for high meat-to-bone ratio, fattiness or leanness as required, rapid growth and non-seasonal breeding. For a power-supply, select for placid disposition, trainability and strength. And for a friend, to help with hunting or controlling stock and to guard property and person, select for the ability to work in a team with a human, to read human communication and follow human wishes.

Is this really what happened? Unfortunately, there is little historical data to go on, because almost all domestication happened in prehistory and recent efforts to breed ‘new’ domesticates have had sparse success. This has led Diamond [1] to argue that domestication requires a species with natural characteristics that match a stringent set of criteria, and that in fact few are suitable. Of the criteria he identifies, those that apply to the domestication of a Man’s Best Friend are: a willingness to breed in captivity, unlike cheetahs; a lack of a nasty disposition in adulthood, unlike brown bears; and group-living with well-developed dominance structure and overlapping home ranges, rather than a solitary and territorial lifestyle.

Wolves fit the bill nicely, and were evidently domesticated at several times and places in human prehistory. These several contributions to the gene pool of the modern dog make it difficult to determine the date of original domestication by molecular methods. (The tree of molecular divergence of all modern dogs is rooted in the ancestor of all the populations contributing to the gene pool, before any domestication.) However, the generally accepted date for the first domestic dog is at least 10,000 BC, well before any other species, and the bewildering variety of modern dogs attests to the power of selective breeding over long periods.

But an extraordinary experiment, carried out since the late 1950s at a fur farm in Siberia, has led to doubts as to what exactly was selected in prehistoric domestication [2]. In this experiment, foxes were selectively bred from individuals that showed the least fear and aggression toward humans, based on rating their spontaneous approaches and tolerance of human contact without biting, under carefully controlled conditions. At the same time, a control strain of fox was bred without such selection.

Intriguingly, the two strains began to diverge in morphological characteristics, as well as in the tameness that was under active selection (Figure 1). Tameness-selected foxes were more likely to have floppy ears, curly tails, and shorter, more rounded faces — all

Figure 1. Young foxes of the tameness-selected strain. These fox kits show white areas in the coat, unlike the plain black of wild ‘silver’ foxes, and a suite of changes to face shape that give them a more ‘cute’ appearance. (Photo courtesy of Brian Hare.)
part of the ‘cute’ package identified by Lorenz [3] as a feature of many young mammals, and thought to be retained into adulthood in domestic dogs and cats as a result of human preferences.

The human preferences are real enough: the same suite of characters has even ‘evolved’ in teddy bears bought for children [4]. Early teddies, inspired by Colonel Theodore ‘Teddy’ Roosevelt, resembled grizzlies with long, flat muzzles and small eyes. But perhaps wolves came to be labradors merely as a result of humans favoring tame individuals? And perhaps the intricate sociality of wolves was also unnecessary: might that furry friend, so winningly glancing back and forth between your eyes and his leash, have just as easily been a fox?

As reported in this issue of Current Biology, Hare and colleagues [5] have probed deeper into the psychological characteristics of tameness-selected foxes, showing that their kits are quick to follow human cues of pointing and eyegaze — better than kits of unselected foxes, and as good as dog puppies tested with the same task. In contrast, non-human primates are poor at this task [6]. Tameness-selected kits were more likely to examine objects that humans had touched, and were better at finding hidden food that a human pointed to. Earlier work had shown that tameness-selected foxes were also more prone to explore, and less deterred by novelty than unselected foxes.

Hare and colleagues [5] conclude that the remarkable sociocognitive abilities of domestic dogs may have developed as a correlated by-product of selection for tameness, and go on to suggest that cognitive abilities of humans too may be a spin-off of selection for some apparently unrelated phenotypic trait — a ‘spandrel’ [7].

Some cautions are in order, however. The sociocognitive abilities of dogs are still under active investigation, and are already known to include rather more than interpretation of whole-arm pointing [8]. (Note that eyegaze and pointing were always performed together by the humans in Hare et al.’s [5] experiments, rather than investigated separately.) Also, specific dog breeds possess behavioral traits that do not depend on training but differ among breeds — for example, King Charles’ spaniels naturally lie flat under thrown nets; collies naturally corral and hold a group of sheep in one place — so are highly unlikely to be correlated traits of tameness.

The question is therefore whether the ability to follow pointing was the primary trait that allowed dog domestication. Hand-reared wolves can learn to follow whole-arm pointing over many trials [9], but tameness-selected foxes do so spontaneously. However, note that even unselected foxes were able to follow pointing to an extent. Perhaps foxes are just naturally better than wolves at picking up such gestures? If so, then the major difference found between the two fox strains may be a function of timidity impairing the abilities latent in all foxes.

The foxes in these experiments are ‘silver foxes’, a melanistic form of red fox Vulpes vulpes, not found in Europe, that has long been trapped and bred for its fur. Selection for tameness, in which only 25% of each generation was allowed to breed, must inevitably have given a somewhat inbred population where rapid genetic change is to be expected. But what mix of inherited traits did foxes bring to the experiment? Red foxes can be monogamous or live in groups of several vixens with a single male; however they forage singly, often at night on small rodents and insects, with little apparent need to understand deictic pointing. But red foxes are also predators of the eggs and chicks of ground-nesting birds, so an ability to read cues about hidden locations from another species’ behavior certainly would pay them. Wolves are pack hunters, more likely to benefit from a different sort of behavior reading, the ability to predict evasive movements from behavioral cues.

These uncertainties in interpretation emphasize that to understand how and when cognition evolved we need to know a lot more about the natural sociocognitive skills of a much wider range of animals, wild and domesticated. Until then, to use the fascinating data from tameness-selected foxes to suggest that human cognitive aptitude might have originated as a mere by-product of selection for some unknown, non-cognitive trait is premature speculation.

References

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