Study finds the brains of modern dog breeds are larger than those of ancient breeds

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Volume-rendered skull model with the endocast representing the reconstructed brain as it is positioned in the skull of the Hungarian vizsla. Upper panel shows the midsagittal section from the right lateral view, lower panel shows the dorsal view of the skull, which was made transparent. Credit: *Evolution* (2023). DOI: 10.1093/evolut/qpad063

Modern dog breeds that are genetically more distant from wolves have a relatively larger brain size compared to ancient breeds that are thousands of years old, according to the findings of Hungarian and Swedish researchers. The increase in brain size cannot be attributed to the roles or life history characteristics of the breeds, suggesting that it is likely influenced by urbanization and a more complex social environment.

Even today, the known four hundred dog breeds have developed relatively quickly and exhibit great diversity, making them a treasure trove for researchers interested in rapid changes within a species. Scientists have long been curious about the factors that affect brain size because the human brain is unusually large in comparison to body size. Comparing the various dog breeds can help answer some questions.

Is there a correlation between brain size and the specific tasks for which a breed was bred? Are there differences, for example, between lap dogs and hunting dogs? Or is it more influenced by life expectancy and the challenges of offspring rearing? What we know for certain is that thinking and cognitive processes require a lot of energy, and maintaining a larger brain is costly.

László Zsolt Garamszegi, an evolutionary biologist at the Ecological Research Centre in Hungary, has been studying the evolution of brain size for a long time. "The brains of domesticated animals can be up to twenty percent smaller than those of their wild ancestors. The likely reason for this is that the lives of domesticated species are simpler compared to those of their wild counterparts. In the safe environment provided by humans, there is no need to fear predator attacks or hunt for food. Therefore, there is no need to sustain the energetically costly large brain, and the freed-up energy can be directed towards other purposes, such as producing more offspring, which is important for domesticated animals."

Niclas Kolm, at Stockholm University, focuses on brain evolution and the link between variation in brain morphology and behavior. "Different dog breeds live in varying levels of social complexity and perform complex tasks, which likely require a larger brain capacity. Therefore, we hypothesize that the selective pressures on the brain can vary within the dog species, and we may find differences in brain size among breeds based on the tasks they perform or their genetic distance from wolves."

This is the first comprehensive study regarding the brain size of different dog breeds, and its preparation took several decades.

Tibor Csörgő, a senior research fellow at the Department of Anatomy, Cell and Developmental Biology at Eötvös Loránd University (ELTE), has been collecting skulls for decades. CT scans of the skulls were performed by Medicopus Nonprofit Ltd. in Kaposvár.

Based on the CT images, veterinarian Kálmán Czeibert reconstructed the brains and determined their exact volume. This invaluable collection was complemented by the Canine Brain and Tissue Bank, operated by ELTE for the past seven years, which enabled the verification of brain volumes calculated from skull images using actual brains. In the end, data was gathered from 865 individuals representing 159 dog breeds, with 48 specimens representing wolves.

According to the results published in the journal *Evolution,* wolves have an average brain volume of 131 cm^3, associated with an average body weight of 31 kg. In the case of dogs in a similar weight category, the brain volume is only about three-quarters of that, approximately 100 cm^3.

This confirms that domestication has also led to a decrease in brain size in dogs. However, what surprised researchers is that the further a dog breed is genetically distant from wolves, the larger its relative brain size

becomes. Contrary to expectations, the original role of the breeds, average litter size, and life expectancy are independent of brain size.

"The domestication of dogs began approximately twenty-five thousand years ago, but for ten thousand years, dogs and wolves did not differ in appearance. Many ancient breeds, such as sled dogs, still resemble wolves today. However, the transition to settlement, agriculture, pastoralism, and the accumulation of wealth offered various tasks for dogs, requiring guard dogs, herding dogs, hunting dogs, and even lap dogs. However, a significant portion of the distinct-looking breeds known today has only emerged since the industrial revolution, primarily in the last two centuries, as dog breeding has become a kind of hobby," says Enikő Kubinyi, a senior research fellow at the Department of Ethology at ELTE.

"The results show that the breeding of modern dog breeds has been accompanied by an increase in brain size compared to ancient breeds. We couldn't explain this based on the tasks or life history characteristics of the breeds, so we can only speculate about the reasons. Perhaps the more complex social environment, urbanization, and adaptation to more rules and expectations have caused this change, affecting all modern breeds."

These findings are supported by research indicating that ancient breeds known for their independence are less attentive to human cues and bark less, thus exhibiting differences in visual and acoustic communication compared to modern breeds.

More information: László Zsolt Garamszegi et al, Evolution of relative brain size in dogs—no effects of selection for breed function, litter size, or longevity, *Evolution* (2023). DOI: 10.1093/evolut/qpad063

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