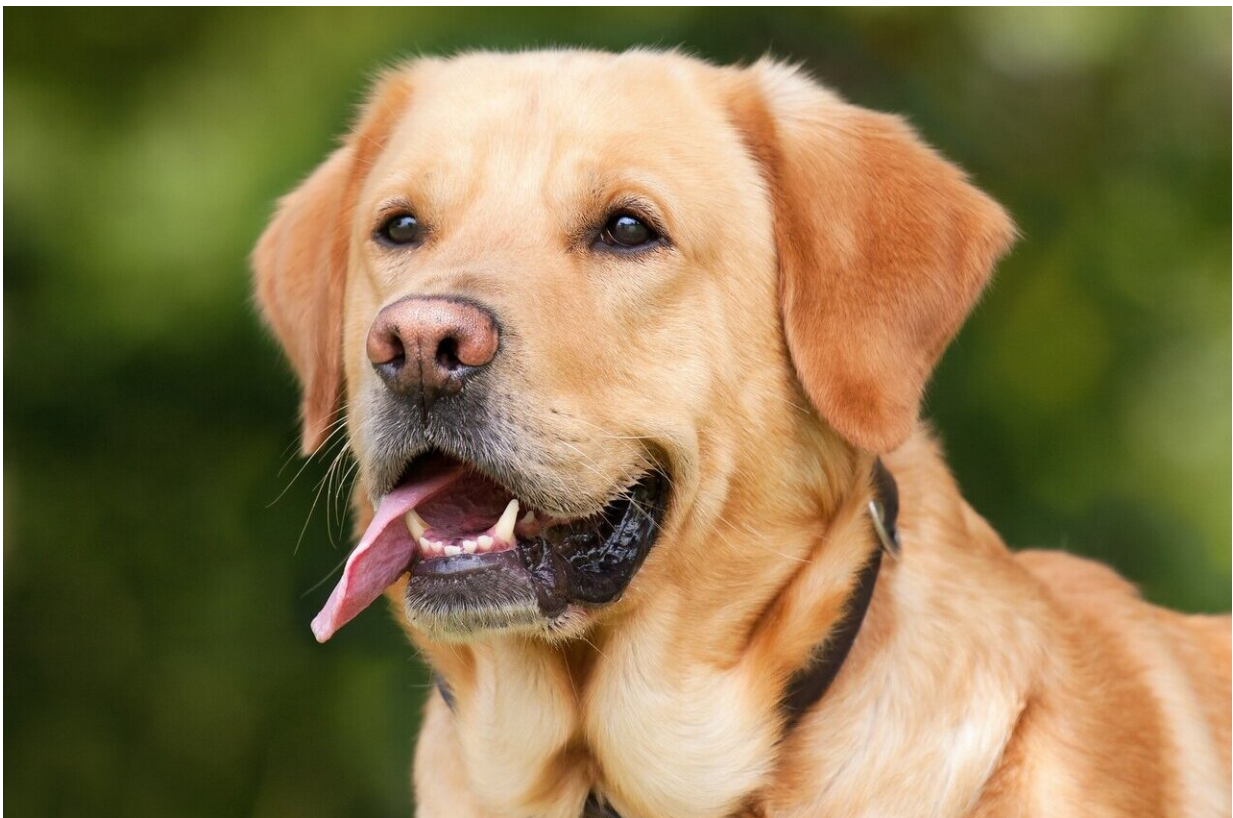# Gut microbiome composition is associated with age and memory performance in pet dogs

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Our gut microbiota can crucially influence our behavior and neurodevelopment. New research from the Ethology Department at the

Faculty of Science at Eötvös Loránd University indicates that dogs' aging mechanism and memory performance are also linked to their gut microbiome composition. According to the study, dogs and humans may have similar mechanisms in cognitive aging.

Dogs have become a valuable model for complex human traits and disorders

In humans, intestinal microbiome composition has been linked to psychiatric conditions such as depression, anxiety, and autism, as well as neurodegenerative disorders, including Parkinson's and Alzheimer's disease through metabolites produced by gut-inhabiting bacteria. The wide range of expected lifespans, a natural inclination to develop dementia, and an environment shared with humans have made companion dogs a promising model organism in aging research. The gut microbiome of dogs is more similar to that of humans than that of mice and pigs.

"Next-generation DNA sequencing techniques have enabled the identification of the taxonomic composition and also the potential functions of the microorganisms, gaining a better understanding of microbial-host interactions," says Tamás Felföldi, assistant professor at the Department of Microbiology, ELTE, Budapest, who usually studies the microbial communities of natural waters, such as the Lake Balaton.

Collecting and analyzing the samples

Eniko Kubinyi, the principal investigator of the Senior Family Dog Project at ELTE, funded by the European Research Council, teamed up with microbiologists to investigate the gut microbiome of a group of companion dogs and examined possible links with age and cognitive performance. "After we tested the memory performance of the dogs at

the Department of Ethology, ELTE, we took them for a walk, and collected fecal samples. We had to immediately freeze the excrement in storage containers to ensure they would provide a valid picture about the bacteria that lived in the dogs guts before defecation."

According to Sara Sandor, a geneticist, "the time limit is important, as some species of bacteria can continue proliferation after defecation, and therefore may falsely outnumber other bacteria in the sample."

Overall, the involvement of family dogs represented a relatively novel approach in this field as it included a huge variety of animals, regarding breed, diet, and life history. This leads to a large statistical variance in their bacterial communities' composition, yet, this approach is crucial if researchers aim to model the natural variability of human populations. "A main limitation of the current study is the relatively low number of subjects, 29 dogs. However, the results of such exploratory studies can facilitate new research efforts, especially if they indicate medically relevant trends in the data," points out Soufiane Bel Rhali, a Ph.D. student.

A link between cognitive performance, age and gut microbiome composition

The researchers found a negative correlation between the abundance of Fusobacteria phylum and the chronological age in dogs. Interestingly, in humans, Fusobacteria were shown to increase with aging and elevated abundance of these microbes have been linked to serious illnesses, like inflammatory bowel disease and colorectal cancer. Therefore, the current finding seems to support an already formed hypothesis that Fusobacteria play a fundamentally different, beneficial role in carnivores as compared with humans. "The identification of such differences between dogs and humans are at least as important as exploring the

shared patterns in gut microbial composition, since ungrounded assumptions of similarity can lower the translational value of intervention studies," notes Kubinyi.

Moreover, the current study found that dogs performing worse in a short-term memory test had relatively more Actinobacteria. This finding can indicate a shared mechanism underlying dogs' and humans' cognitive aging, since Actinobacteria were also shown to be more abundant in the intestines of Alzheimer patients.

A link between cognitive performance, age and gut microbiome composition in companion dogs was hypothesized but not described before. The new research, although preliminary regarding the association between cognition and gut microbiome composition, opens up new venues in canine aging and neurodevelopmental research.

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