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Diet, Exercise, Stimulating Environment Helps Old Dogs Learn

According to conventional wisdom, old dogs and new tricks aren't a good match. But a new study of beagles finds that regular physical activity, mental stimulation, and a diet rich in antioxidants can help keep aging canine—and perhaps human—brains in tip-top shape. The research, supported by the National Institute on Aging (NIA), a part of the National Institutes of Health (NIH), is among the first to examine the combined effects of these interventions and suggests that diet and mental exercise may work more effectively in combination than by themselves.

During the two-year longitudinal study, William Milgram, Ph.D., of the University of Toronto, Elizabeth Head, Ph.D., and Carl Cotman, Ph.D., of the University of California, Irvine and their colleagues found older beagles performed better on cognitive tests and were more likely to learn new tasks when they were fed a diet fortified with plenty of fruits, vegetables and vitamins, were exercised at least twice weekly, and were given the opportunity to play with other dogs and a variety of stimulating toys. The study is reported in the January 2005 *Neurobiology of Aging.*

Dogs are an important model of cognitive aging, and these findings could have important implications for people. Like humans, dogs engage in complex cognitive strategies and have a more complicated brain structure than many other animals. Dogs also process dietary nutrients in ways similar to humans. And like people, dogs are susceptible to age-related declines in learning and memory, and can develop neuropathology similar to Alzheimer's disease.

"This research brings a note of optimism that there are things that we can do that may significantly improve our cognitive health," says Molly Wagster, Ph.D., program director of the NIA's Neuropsychology of Aging Branch. "In this case, more was better. Although each factor

alone was capable of improving cognitive function in older animals, the combination was additive, pointing to a healthy lifestyle as the most beneficial approach. While we have yet to demonstrate these benefits in people, research such as this gives us new ways to think about the aging brain and what we can do to keep it intact."

For the study, the researchers divided 48 older beagles (ages 7 to 11) into four groups. One group was fed a regular diet and received standard care; a second group received standard care but was fed an antioxidant fortified diet, consisting of standard dog food supplemented with tomatoes, carrot granules, citrus pulp, spinach flakes, the equivalent of 800 IUs of vitamin E, 20 milligrams per kilogram of vitamin C, and two mitochondrial co-factors—lipoic acid and carnitine; the third was fed a regular diet, but their environment was enriched (regular exercise, socialization with other dogs, and access to novel toys); the fourth group received a combination of the antioxidant diet as well as environmental enrichment. In addition, a set of 17 young dogs (ages 1 to 3) were divided into two groups, one fed a regular diet and the other fed the antioxidant fortified diet.

The fruits and vegetables added to the antioxidant fortified diet was the equivalent of increasing intake from 3 servings to 5 or 6 servings daily. Previous research suggests that antioxidants might reduce free radical damage to neurons in the brain, which scientists believe is involved in age-associated learning and memory problems. Mitochondrial co-factors may help neurons function more efficiently, slash free radical production and lead to improvements in brain function. Other studies suggest that stimulating environments improve learning ability, induce beneficial changes in cellular structure, may help the brain grow new neurons, and increase the resistance of neurons to injury.

As the study progressed, researchers tested the dogs with a series of increasingly difficult learning problems, including a task in which the animals needed to learn whether a treat was hidden under a black or white block (black/white discrimination). Later, the treat was hidden under the opposite block so the dogs had to relearn the task (reversal learning).
Overall, older dogs in the combined intervention group did the best on these learning tasks, outperforming dogs in the control group (standard diet, standard care) as well as those that

(more)

received either the antioxidant diet or environmental enrichment. However, older beagles that received at least one of these interventions also did better than the control group. For instance, all 12 of the older beagles in the combined intervention group were able to solve the reversal learning problem. In comparison, 8 of the 12 dogs that ate the antioxidant diet without environmental enrichment and 8 of the 10 that received environmental enrichment without the antioxidant diet solved the problem. Only two of the eight older dogs in the control group were able to do this task. Dietary intervention in the younger canines had no effect.

"The combination of an antioxidant diet and lots of cognitive stimulation—which was almost the equivalent of going to school every day—really did improve brain function in these animals," says Dr. Head. "We're excited about these findings because the interventions themselves are relatively simple and might be easily translated into clinical practice for people."

The NIA leads the Federal research effort on aging in general and on aging and memory, including Alzheimer's disease. For more information on these topics, the public and media are invited to visit the NIA's websites. Information on memory and Alzheimer's disease may be viewed at www.alzheimers.org, the NIA's Alzheimer's Disease Education and Referral (ADEAR) Center website. The general public also may call the ADEAR Center toll free at 1-800-438-4380. General information on health and aging may be viewed at www.nia.nih.gov. Publications may be ordered online at www.niapublications.org or by calling the NIA Information Center toll free at 1-800-222-2225.

* Milgram, N.W., Head, E., Zicker, S.C., Ikeda-Douglas, C.J., Murphey, H., Muggenburg, B., Siwak, C., Tapp, D., Cotman, C.W. Learning ability in aged beagle dogs is preserved by behavioral enrichment and dietary fortification: a two-year longitudinal study. Neurobiol Aging, 2005, 26: 77-90.

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