One Health Research Project Abstract

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Research Abstract:

Alzheimer's disease is the leading cause of dementia, occurring in approximately 1 in 10 Americans over the age of 65. Various nonhuman models have been used in preclinical studies of Alzheimer's disease, but these models typically involve laboratory populations housed in controlled, artificial environments, which limits their translational potential. Companion dogs are an ideal model for the study of aging-related diseases in a One Health framework that examines how environments shared by humans and other animals influence health outcomes in both species. In contrast to most model organisms, dogs exhibit remarkable variation in genetics, lifestyle, and environment, with the latter two factors often paralleling those of their human caretakers. Because companion dogs share our environment, they can be exposed to the same pollutants, chemicals, and air or water quality issues as people. Importantly, dogs also experience age-related cognitive decline, in some cases developing canine cognitive dysfunction (CCD), a neuropathological disorder with striking parallels to Alzheimer's disease. CCD involves impaired memory, spatial navigation, and learning ability, as well as changes in sleep patterns and social interactions. CCD is also characterized by deposition of amyloid-beta plaques in the brain, a key biomarker of Alzheimer's disease. Thus, dogs may provide a powerful translational model for studies investigating the biological and environmental determinants of age-related dementias. In addition to this translational potential, studies of cognitive aging in dogs will be critical for advances in veterinary medicine, and specifically the development of treatments and interventions that can promote healthy longevity in our canine companions. And because dogs provide a myriad of benefits to human health and well-being – including exercise, direct companionship, and facilitation of social interactions – advances that promote longer and healthier lives in dogs have direct potential to benefit human health and wellbeing by extending the time that people can reap the benefits of these human-animal interactions.

My proposed project involves the development and implementation of behavioral assays for the study of dog cognitive aging. This research will contribute to the Dog Aging Project, a longitudinal, nationwide study following over 40,000 companion dogs through community science. *With overall goals of understanding and integrating biological and environmental determinates of aging to advance both canine and human health, the Dog Aging Project embodies a One Health philosophy.* I have recently developed and pilot tested an assortment of cognitive assessments for my study, including 1) a neuropsychological battery of five tasks that target aspect of cognition impaired in Alzheimer's disease, such as memory, executive function, and social interaction, 2) community science tasks intended for at-home deployment with tens of thousands of Dog Aging Project participants in varied environments across the U.S., from rural to urban, and 3) automated computer touchscreen-based tasks that assess reversal learning and spatial memory, based on protocols that successfully detected early cognitive impairment in rodent models of Alzheimer's disease. I have successfully piloted the neuropsychological test battery and touchscreen tasks with > 50 dogs from the local community, for whom I also collected physical activity data using a wearable accelerometer. Additionally, the first community-science measure I developed has already been successfully deployed with a cohort of dogs in the Dog Aging Project, demonstrating feasibility of this approach.

During the period of support, I will build on this foundation in the following ways. First, I will complete the design and programming of a second community science task assessing short-term memory in dogs. Once finalized, this task will be made available to Dog Aging Project participants, enabling data collection with tens of thousands of dogs from diverse environments throughout the United States. Second, I will complete statistical analyses in my pilot study of dogs tested in the neuropsychological battery and touchscreen-based tasks, to identify which specific measures are most sensitive to age-related changes in cognition. I will then develop a streamlined battery consisting of a smaller number of tasks, that can be used in a new cohort of the Dog Aging Project, focused specifically on cognitive aging. Ultimately, I aim to leverage the resources of the Dog Aging Project to assess questions about *shared environmental risk factors for dementia in humans in dogs.* These analyses will be made possible by the wealth of environmental data collected by the Dog Aging Project, encompassing variables ranging from pesticide/herbicide use in the yard to neighborhood walkability and green space access. *Collectively, these studies have potential to advance our understanding of both biological and environmental determinates of healthy and pathological cognitive aging, and to inform policies and interventions that can promote health in humans and our companion animals.*