Canine cognition

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The following special issue of *Learning & Behavior* is entirely devoted to the cognitive (and sensory) abilities of dogs (*Canis lupus familiaris*). As far as we know, apart from humans (and maybe chimpanzees), such a specio-centric orientation is rare in the literature and needs special justification.

There are, of course, many practical reasons for bringing dogs to the forefront. The species' enormous impact on society, spanning a range from man's best friend to "bad dogs" is evident, as is the practical importance of a better understanding of the variables controlling dog behavior for the growing number of industries that utilize the *behavior* of domestic dogs. But there is also much to learn about dog's *learning* abilities. Although dog research has a long history, with the studies of Darwin, Lubbock, and Pavlov as famous historical examples, there are still many gray areas, with ambiguous evidence and hypotheses under revision.

From a fundamental scientific point of view, dogs are interesting because they provide a model for short-term *cognitive evolution*. When considering dog–human interactions and the apparent sensitivity and skills dogs show in these interactions, researchers have been led to suggest a main role of domestication, that is, direct human selection for desirable traits (e.g., tameness, attention to humans, sociability). Hence, although the importance of individual experience during a dog's lifetime must not be underestimated, dogs have become particularly interesting for comparative psychologists because of the assumed influence of domestication on cognition and behavior. The possibility to compare dogs with their wild progenitor, the wolf (see the article by Lea & Osthaus, this issue), and insights from experimental domestication

studies with another canid, the silver fox (see the article by Lane, this issue), have fueled this interest.

The "domestication hypothesis" has been dominant for three decades but has now been challenged in regard to new research comparing dogs and wolves under fully comparable conditions (i.e., equal development). A more ecologically based view of dogs, taking into account the behavior and cognition of free-ranging dogs and the differences between dogs and wolves with respect to both their feeding niche and social organization, has revised the more psychological and pet-dog-based view on canine cognition.

We will never know exactly what happened at the onset of dog speciation. But it is quite evident that this process was characterized by two kinds of transitions, with regard to the feeding ecology from group hunting of ungulates to human refuse scavenging and, with regard to sociality, from pair bonding and alloparental care to promiscuous and mostly maternal care. These two transitions have obviously led to a considerable reduction of dogs' reliance on conspecifics (pack members) for both foraging and pup rearing—compared with wolves—and at the same time to an increase in the dependence on humans.

One of the most pressing questions at the moment is whether this increased dependence on humans has led to the evolution of specific, "human-like" psychological processes. Is it justified to assume common psychological processes in humans and dogs, only because dogs and humans have shared a common environment and similar selective pressures for tens of thousands of years? Lea and Osthaus (this issue) have made a huge effort to contrast dog cognition with what is known about cognition in species that are comparable either phylogenetically, ecologically, or anthropogenically. As a result of these comparisons with wolves, cats, spotted hyenas, chimpanzees, dolphins, horses, and pigeons, the authors concluded that dog cognition is influenced by all three of these factors, but does not stand out in comparison with other species (i.e., being far better than the average or the predictable trend). Without doubt, this conclusion would be surprising, if not provocative, to many dog researchers who believe that in the course of domestication the dog's sensitivity to human

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social cues, and the resulting social behavior, has reached a level of human-compatible social and cognitive sophistication unknown in any other nonhuman animal. For instance, overimitation has only been documented for humans, in strong contrast to a complete absence in primates, until two recent papers have provided (first) evidence of this social learning phenomenon in dogs (see Huber et al., this issue).

Although we invited dog researchers to contribute to the question of the dog's position in the evolution of cognitive traits, with the debate fueled by Lea and Osthaus' opening article, we did not aim at providing a straightforward answer in this special issue. Rather, our goal was to showcase the diversity of canine research. We have accomplished this goal with articles spanning current topics in canine cognition by faculty and their students across the world. We briefly outline the special issue so you can enjoy a dog's dinner.

To set the stage for the empirical articles, the review by Lea and Osthaus places canine cognition in a comparative context. The empirical articles begin with several articles on social cognition. Duranton and Gaunet show evidence for human-like skills in regard to behavioral synchronization and affiliation in dogs. Sanford, Burt, and Meyers-Manor present an intriguing demonstration of prosocial helping in dogs using the trapped-person procedure. Using a slick apparatus and setup, Huber and colleagues show dogs can copy irrelevant actions from caregivers indicating this ability may not be unique to humans. Tan, Walker, Hoff, and Hare explore factors that contribute to how dogs perceive and may form bonds with strangers. Kiss, Kovács, Szánthó, and Topál show how the similarity between an unfamiliar person and a dogs' caregiver can influence preference when facing an unsolvable problem. In two articles, Dwyer and Cole and Johnston, Huang, and Santos describe findings related to the use of using human cues when localizing objects. Building on choice by dogs, Chase and George add to the growing evidence that dogs make suboptimal choices, while Fernand, Amanieh, Cox, and Dorey show dogs fail to take the size of a reward into account as a deciding factor for choice, and McGetrick

and Range provide an informative review on inequity aversion.

In relation to perception and memory, Keep, Zulch, and Wilkinson present evidence for the Müller-Lyer illusion and Sluka and colleagues show dogs do not use spatial location in a test of incidental spatial memory. Vernouillet, Stiles, McCausland, and Kelly compare individual dog performance across four motoric self-regulation tasks and discuss issues why there is a growing trend in failures to find tasks related to each other when one might expect there to be a positive relation. Piotti and colleagues test aging in dogs on several cognitive tests and find learning advantages for younger dogs, adding to the developing literature using dogs as a model for human aging.

In the cognitive neuroscience realm, Kovács, Kosztolányi, and Kis measure brain activity while dogs are sleeping via polysomnography and present the first rapid eye movement density functions in dogs. Thompkins and colleagues add to the emerging awake canine fMRI research and show separate brain areas for processing human and conspecific faces that are not distinct due to familiarity or emotional valence. Siniscalchi, d'Ingeo, and Quaranta present data indicating asymmetrical emotional modulation of the canine brain and cardiac response to human emotions in faces. We end the special issue with an article by Lane that presents a new perspective on the evolution of the famous farm foxes in the southern Soviet Union, which has implications for domestication.

We hope this collection of articles continues to inspire researchers. We would like to thank all the contributors to this Special Issue on Canine Cognition for allowing us to assemble an excellent collection of articles. We appreciate the assistance of our colleagues in providing reviews for the articles. Lastly, we would like to thank the Psychonomic Society and Jon Crystal for inviting us to serve as guest editors of this Special Issue on Canine Cognition.

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