

Chapter 1: Of Dogs and Bonds

Jeffrey R. Stevens

Jeffrey R. Stevens (corresponding author)

Department of Psychology and Center for Brain, Biology & Behavior, University of Nebraska-Lincoln, Lincoln, NE, USA

E-mail: jeffrey.r.stevens@gmail.com

Abstract

Dogs take on a number of roles in human lives from free-ranging animals in our streets to companions in our homes and working and assistance animals throughout our society. The unique bond between dogs and humans has resulted in an explosion of interest and research on this species and their interactions with people. Yet there is not as much cross-talk between researchers focusing on canine cognition and those studying canine-human interactions. The aim of the 69th Nebraska Symposium on Motivation was to bring together researchers from psychology, biology, neuroscience, anthropology, and social work to delve deeper into the canine-human bond. The authors in this book describe evolutionary, hormonal, and neuroscience perspectives for understanding dog behavior and cognition for both companion dogs and free-ranging dogs on the streets of India. We end with experts in canine-human interaction who report on the effects of interacting with dogs on the psychology and well-being of college students. Only by combining perspectives to study both ends of the leash can we truly understand our unique connection with dogs.

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In four of Charles Darwin's classic works (Darwin, 1859, 1868, 1871, 1872), the domestic dog (*Canis familiaris* or *Canis lupus familiaris*)¹ featured prominently, offering key examples to illustrate his ideas about evolution, domestication, comparative behavior and cognition, and emotional expression. Darwin held a clear fondness for dogs, and, when replying to letters detailing the "sagacity" of dogs, he remarked "I can believe almost any thing about them" (Darwin, 2014). Despite the early interest in their behavior and cognition by a number of leading scientists, dogs were rarely subject to serious investigation as a study species for 150 years. In 2000, the number studies on dog behavior and cognition began increasing rapidly, as more behavioral researchers worldwide began to work with them (Aria et al., 2021; Bensky et al., 2013). This research covers both the social and nonsocial domains of behavior and cognition (Bensky et al., 2013; Miklósi, 2015). In the social domain, researchers study how dogs interact with social agents (both conspecifics and heterospecifics) in areas such as play, social relationships, perspective taking, cooperation, communication, and social learning. In the nonsocial domain, researchers study how dogs interact with their physical environment by investigating perception, learning, memory, categorization, physical reasoning, numerical cognition, and spatial cognition. Combined, this work has highlighted dogs as an ideal study system for understanding the evolution of behavior and cognition, domestication and co-evolution, applied animal science, and even human health (ManyDogs Project et al., 2022).

Many species exhibit fascinating aspects of behavior and cognition. But what sets dogs apart is their relationship with humans. No other species has been invited into our homes, farms, schools, hospitals, libraries, and airports to the degree that dogs have. They have an exaggerated presence in the media we consume, from beloved cartoon characters such as Peanut's Snoopy to a pudgy little pug setting the morning mood for millions of people on social media (Graziano, 2022). Further, many people identify as "pet parents" and treat their dogs as they would their children (Volsche, 2021). Mirroring the dog cognition trends, we have recently witnessed a sharp increase in studies of canine-human interaction, exploring the motivational, emotional, cognitive, physiological, and neural mechanisms of dogs on human psychology and well-being. Despite increased interest in both dog cognition and canine-human interaction, there is not as much cross-talk between these fields as one might hope for. Here, we bring these research fields together to take seriously the questions of why dogs play such an important role in our hearts and minds and why the canine-human bond is so strong.

1.1 What Is a Dog?

To understand the canine-human bond, we must understand the dog's origin story. Like many origin stories, the dog's is controversial and fraught with uncertainty. For our purposes, we will keep things fairly simple. Dogs diverged from a common ancestor with wolves (*Canis lupus*) between 15,000-30,000 years ago. While the fossil record supports the more recent divergence, genetic approaches indicate earlier divergence (Miklósi 2015). In addition to uncertainty surrounding *when* exactly dogs originated, there is uncertainty *where* dogs originated. Genetic evidence points towards Asia, but it is not clear if they originated in east Asia or west Asia/Middle East/Europe (Miklósi 2015). To add a final layer of uncertainty, there are multiple competing hypotheses about *how* dogs diverged; that is, what environmental circumstances

¹Different authors use different species concepts to classify domestic dogs. Those who employ the biological species concept refer to dogs as *Canis lupus familiaris*, while those who employ the ecological species concept use *Canis familiaris* (Miklósi 2015). For consistency throughout the book, we will use *Canis familiaris*.

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provided the pressure for divergence. The two primary hypotheses boil down to whether humans played a more passive or active role in domesticating dogs (see Wirobski et al. chapter).

Despite this ambiguity about when, where, and how dogs originated, the key point is that dogs have lived and co-evolved with humans for thousands of years, resulting in a close relationship between us. Being the first domesticated animals has given dogs the opportunity to evolve traits that make them well suited to living with us. There are many shared traits between dogs and their closest living relative the wolf. However, of particular interest are behavioral and cognitive traits exhibited uniquely by dogs. Comparisons between dogs and wolves can offer insights into these similarities and differences, but they face challenges, including maintaining equivalent rearing and socialization practices between the two species (see Wirobski et al. chapter) as well as assessing the genetics of the wolf populations to ensure they are not wolf-dog hybrids. With these safeguards in place, we can begin to explore possible species differences that are attributable to domestication.

These aspects of social cognition may be important in facilitating a strong connection with humans. But dogs have taken this a step further by potentially evolving traits that not only facilitate a relationship with humans but actually exploit existing cognitive systems in humans to manipulate us. For example, oxytocin is a neuropeptide hormone associated with social bonding between parents and infants (Feldman et al., 2007) and between romantic partners (Algoe et al., 2017). Eye contact between mothers and infants is associated with changes in oxytocin levels (Kim et al., 2014). Likewise, owners gazing into the eyes of their dogs results in an oxytocin boost in both owner and dog (Nagasawa et al., 2015). So dogs may be co-opting an existing physiological system in humans associated with bonding. They may have even taken a step further to evolve morphology that hijacks our emotions by evolving specific muscles around their eyes that result in ‘puppy-dog eyes’ (Figure 1.1; Kaminski et al., 2019).



Figure 1.1: Dogs have specific muscles to generate ‘puppy-dog eyes’. Wolves do not have these muscles (Photo credit: [Bharathi Kannan](#) on [Unsplash](#); licensed for free use).

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1.2 Role of the Dog

Over the thousands of years of co-evolution with humans, dogs have filled various roles in human society, with the number of roles increasing more recently.



Figure 1.2: Examples of (a) free-ranging dogs, (b) companion dogs, (c) working dogs, and (d) assistance dogs (Photo credits: (A) [Anoir Chafik](#) on [Unsplash](#), (B) [Anna Dudkova](#) on [Unsplash](#), (C) [William Milliot](#) on [Unsplash](#), and (D) [PersianDutchNetwork](#) on [Wikipedia Commons](#); all licensed for free use or under under CC BY-SA 3.0).

1.2.1 Free-ranging dogs

Of course, the original ‘role’ of the dog was not so much a role but an association, with dogs just hanging out around human settlements. Currently, there are estimated to be 900 million dogs worldwide (Gompper, 2013). Incredibly, about 80% of these dogs are free-ranging dogs (Figure 1.2a)—also called village dogs, street dogs, feral dogs (Lord et al., 2013). While in North America and Europe, free-ranging dogs are relatively rare, they are quite common throughout the Global South. This fact likely explains why the vast majority of research on dog behavior omits

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this critical and ubiquitous population of dogs. Fortunately, a number of researchers are attempting to remedy this oversight (see Bhadra and Sarkar chapter).

1.2.2 Companion dogs

Arguably the most common role of dogs considered by people is that of a pet or companion animal. Dogs live with us in our homes or on our property, where we provide them food and shelter and they provide us with companionship (Figure 1.2b). This can range from farm dogs who may live in barns or dog houses to the highly pampered “fur babies” doted on by pet parents (Blouin, 2013). Thus, the role of companion dogs ranges from property protector to cherished member of the family, potentially substituting for human children (Volsche, 2021).

In many countries worldwide, the number of companion dogs is increasing. In the United States, for instance, the percentage of households with dogs increased from 38% in 2016 to 45% in 2020 (American Veterinary Medical Association, 2022). The recent COVID-19 pandemic in particular drove up interest in dog adoptions as people were looking for more companionship in difficult times (Ho et al., 2021). Mirroring the increase in interest in dogs by the general public, research on canine behavioral science has grown rapidly in the last two decades (Aria et al., 2021), with the vast majority of studies using pet dogs as their study sample (Bensky et al., 2013).

1.2.3 Working dogs

One of the early roles that dogs likely provided humans was protection from predators and competitors. Since then, we have selected dogs to fill a number of working roles for us (Figure 1.2c). In fact, many breeds of dog were specifically created to fill different working roles. Some of the more breed-specific working roles include livestock guarding, herding, hunting, and sled pulling (Lord et al., 2016). Dogs have been bred to serve in these roles for hundreds or thousands of years. More recently, we have trained and sometimes bred dogs for roles that focus on their amazing olfactory abilities. We have created a number of different roles for detection dogs, including search and rescue and the detection of explosives, cadavers, drugs, disease, and threatened or invasive species (Bray et al., 2021; Helton, 2009). Given the agricultural, military, law enforcement, medical, and conservation applications of these dogs, increasing research interest is being directed toward these dogs to improve their breeding, selection, training, performance, and welfare.

1.2.4 Assistance dogs

Though assistance dogs are actually a subcategory of working dogs, I separate them out due to their unique influences on our physical and mental health and well-being (Figure 1.2d). While many dog owners may feel that their well-being is improved by having a dog, general benefits to owning a dog (the so-called “pet effect”) are not well supported by larger-scale research (Herzog, 2011). This is in part because dogs can provide costs as well as benefits to people. Assistance dogs are working dogs that perform some form of assistance or support for people (McMichael & Singletary, 2021). The more specific nature of the assistance can in fact provide direct benefits to people.

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There are several types of assistance dogs. *Service dogs* refers to a dog trained “to perform specific tasks or do specific work for the benefit of an individual with a recognized disability” (Americans with Disabilities Act), which includes physical, sensory, or psychiatric assistance. Service dogs are highly trained and work with a specific individual. *Therapy dogs*, in contrast, do not perform specific tasks beyond allowing other individuals beside their owners to pet and interact with them. This can occur in formal setting such as mental health therapy offices or more informally through visits to facilities such as retirement homes and hospitals. Therapy dogs are trained to interact with people other than their owners. *Facility dogs* are similar to therapy dogs but, instead of being brought in specifically for short-term interactions, they are regularly present in a facility such as a school, retirement home, or hospital. *Emotional support dogs* are dogs that provide physical, psychological, and/or emotional support through companionship (McMichael & Singletary, 2021). There are no training requirements for emotional support animals, and they interact only with their owner in that capacity. With the increasing numbers of assistance animals in society, research interest in them is rapidly growing.

1.2 Canine Cognition and the Human Bond

With the roles of dogs increasing in our society, understanding the relationship between dogs and people becomes ever more important. The aim of the 69th annual Nebraska Symposium on Motivation and this volume was to bring together researchers from psychology, biology, neuroscience, anthropology, and social work to delve deeper into the canine-human bond. The advantage of this approach is that it engages experts in dog cognition with experts in canine-human interaction. Only by studying both ends of the leash can we truly understand our unique connection with dogs.

In chapter 2, the volume begins with Wirobski, Lazzaroni, Marshall-Pescini, and Range setting the stage for understanding canine-human relationships by reviewing what we know about dog origins and domestication. This chapter begins by summarizing a number of different hypotheses about the origins of dogs and their history of domestication. The authors then argue that behavioral data alone may not be sufficient to distinguish between these hypotheses. Instead, integrating hormonal data with behavior may best test these hypotheses. Specifically, aspects of the hypothalamo-pituitary-adrenal axis and the oxytocinergic system can provide insights into dog origins and the human-canine relationship. The authors then describe a set of studies comparing wolves, comparably raised dogs, pet dogs, and free-ranging dogs. These studies investigated differences in dog and wolf motivations to interact with humans, as well as effects of human interactions and social contact on dog and wolf behavior and hormone levels. While wolves share some behavioral and hormonal responses with dogs, they differ in some situations. Investigating the role of life experience and hormonal mechanisms can go a long way to help us understand the canine-human bond.

In chapter 3, Smith and Katz explore the behavioral and neuroscientific evidence for the dog-human bond. They begin by reviewing the state of knowledge for key measures of socio-cognitive abilities of dogs, focusing on the object-choice task and the unsolvable task. They then dive into how canine researchers have adapted measures of human attachment to measure attachment between dogs and humans. With this background in place, the authors review the current state of the field of canine neuroscience, a burgeoning research area that noninvasively measures brain activity in awake and unrestrained (but highly trained!) dogs in a scanner. Critically, researchers can use functional magnetic resonance imaging (fMRI) to measure neural

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activity in dogs as they receive visual, olfactory, or auditory stimuli. This nascent research area has already yielded critical insights into dog behavior and cognition as well as intriguing parallels with human neuroscience. The authors end by applying a neural model of human attachment to dogs, providing a theoretical framework for better understanding the canine-human bond.

In chapter 4, Bhadra and Sarkar describe a research program focused on understanding free-ranging dogs. Despite decades of studying so many other species, we have only just recently begun recording the natural history of domestic dogs in their natural environment—the streets, neighborhoods, and countrysides adjoining human settlement. The authors describe groundbreaking, foundational natural history information about free-ranging dogs in India. They begin by cataloging births and deaths of free-ranging dog pups, recording the seasonality of birth, along with the mortality rate across ages of the pups. The authors then describe characteristics and qualities of dens that mothers choose with respect to how they exploit aspects of the human environment. Once pups are born, the next phase of maternal care is nursing the pups, which is tied directly to key theories of parental investment and parent-offspring conflict. Though mothers provide most of the parental care for their pups, the authors describe the extent to which allo-mothers and putative fathers contribute to pup care, including nursing, play, and protection. Finally, the authors end with a series of studies exploring how free-ranging dogs interact with humans by investigating (1) how they detect high-quality food found in human garbage, (2) how they understand and use human communication cues, and (3) how they trade-off food vs. social rewards (petting) from humans. In short, this chapter introduces us to the way that most domestic dogs on the planet interact with humans—not those dogs kept as pets, but those that experience both the spoils and perils of interacting with humans on their own terms.

In chapter 5, Pendry and Carr demonstrate direct effects of dogs on human well-being. They first introduce the field of anthrozoology—which studies human-animal interactions—and the different forms of animal-assisted interventions. In particular, they focus on animal visitation programs in which animal-handler teams visit university campuses to allow students to briefly interact with the animals. The authors frame the issue in a transactional model that describes how stress and human-animal interactions influence the stress system, which in turn influences physical and mental health. With this in mind, they describe a series of studies in which university students experience animal visitation programs or control conditions to assess the effect of animal interactions on self-reports of well-being, as well as physiological measures such as cortisol. Critically, they carve up the study populations based on individual differences such as experience with depressive symptomatology, mental health conditions, and/or academic deficiency to examine how useful the programs are to certain subpopulations. Combined, these studies use rigorous methods to directly assess not only whether these animal-assisted interventions work but also for whom and under what circumstances they may work.

In chapter 6, Binfet reflects on what he has learned over the last 10 years of implementing a dog-focused animal visitation program at the University of British Columbia, Okanagan campus. His *Building Academic Retention through K9s* or B.A.R.K. program has helped thousands of university students cope with the stresses of college life. Building a program like this involves selecting and training a large numbers of dog-handler teams, and this chapter starts by describing key characteristics of both therapy dogs and their handlers, keeping in mind the welfare of the dogs in addition to the efficacy of the interventions. Binfet then describes a number of studies conducted as a part of the program. The first investigated the importance of touch as a part of the animal interaction by comparing measures of well-being across groups who petted/touched the dog, only viewed the dogs, or only interacted with a handler. Born out of the COVID-19 pandemic, another study investigated the efficacy of virtual interactions with dogs by

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comparing groups who had live vs. pre-recorded virtual encounters with dogs or handlers. Finally, the chapter ends with a look towards future research questions that address the effects of program duration and dog-handler experience on efficacy, as well as the importance of considering implementation fidelity and diversity in handlers and participants.

Dogs have a special place in the hearts of millions of us worldwide but also in human history. In fact, the crucial evolutionary link between dogs and humans underlies the bonds that we currently share with this amazing species. Understanding their behavior and cognition in our homes and neighborhoods not only satisfies our curiosity about this endearing species but directly informs how we interact with them as companions and as providers of support and well-being.

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