Chapter 9
Looking at Dogs: Moving from Anthropocentrism to Canid *Umwelt*

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Abstract As a companion to humans, the domestic dog is naturally interpreted from a human-centered (anthropocentric) perspective. Indeed, dog behavior and actions are often explained by using anthropomorphisms: attributions to the dog that would hold if the actor were human. While sometimes useful, anthropomorphisms also have the potential to be misleading or incorrect. In this chapter we describe work to replace an anthropocentric perspective with a more dog-centered research program. First we detail research systematically testing anthropomorphisms of emotional complexity—the appearance of guilt and jealousy—that are made of dogs, by testing the context of appearance of the "guilty look" and by testing advantageous and disadvantageous inequity aversion. Relatedly, we describe research looking at the contribution of specific dog physical attributes to human preference and anthropomorphizing. Finally, we identify anthropocentric and canid-centric elements of our own and others' research, and suggest ways that research can be more sensitive to the dog's *umwelt*.

9.1 Introduction

The domestic dog is once again a subject of science. In the twentieth century, dogs were most often recognized in behavioral science for their role in Pavlov's development of conditioning theory. By contrast, the new study of dogs,

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"dog cognition" research, views dogs less as a neural system exemplifying a learning process than as a species itself of interest for its skills.

Canis familiaris is unique among psychological and ethological scientific subjects for its ubiquity in Western culture and households. And this ubiquity itself affects how the dog has been investigated: for in this research with dogs, the subjects are most often *owned* dogs, household pets, whose social group is as much humans as it is conspecifics. This fact distinguishes them from almost all other research subjects, in lab, farm, or field; either domesticated or not.

In part for that reason, dogs are a subject about which much information might appear to be known already: far from exotic and unknown, the species is familiar, recognizable, and navigates a human-centered world daily. The primary interlocutors with dogs are dog owners, who manage what is often one or two decades of living together with relatively few mishaps (Sanders 2003). Owners' alleged "understanding" of their dogs is the backdrop for new scientific studies of dogs. While scientists approach the dog *ab initio*, with no assumptions other than species identification and genus affiliation, owners typically make regular assertions about what their dogs, or even all dogs, can understand, see, experience, want, believe, and know.

A scientific approach to animals calls these assertions likely *anthropomorphisms*—that is, claims that a nonhuman animal has attributes characteristic of (and only proven of) human animals. As a matter of method and philosophy, most researchers try to avoid rampant anthropomorphisms. While any particular claim about another species' abilities may indeed be correct, the determination of the claim's correctness is considered an empirical matter, not one that can simply be asserted. To anthropomorphize, then, is to make an unfounded claim. Neither is it explanatory (Wynne 2007).

Nonetheless, insofar as anthropomorphisms represent simply the human perspective on, or way of seeing, non-humans, some degree of anthropomorphizing may be inevitable (Horowitz and Bekoff 2007). Indeed this is just one kind of anthropocentrism that is characteristic of and in some cases definitional of behavioral science. With this in mind much of the research in our lab has been to address and redress anthropocentrism by (a) directly addressing anthropomorphisms made of dogs, (b) determining what prompts specific anthropomorphisms to begin with, and (c) developing methods for a more dog-centered research approach.

This chapter briefly reviews the history of use of anthropomorphisms, in behavioral science and pre-scientifically. We then describe contemporary attitudes about these assertions, as well as their investigated effects on the dog-human dyad. Having introduced the topic conceptually, we review empirical studies largely from our lab (the Horowitz Dog Cognition Lab at Barnard College) exploring the appropriateness of specific attributions of emotions made to dogs. As a complement, we describe research into why we anthropomorphize.

Relatedly, in the final section we review recent dog cognition research with this anthropocentric/*umwelt* lens: both highlighting methodological elements which are anthropocentric in approach, and could be re-considered, and also methods attentive to the *umwelt* of the dog.

9.2 Anthropomorphisms

Anthropomorphisms pre-date contemporary scientific and lay attitudes to animals; representations in Paleolithic art, forty thousand years ago, have been described as anthropomorphic (Mithen 1996). For millennia, weather and even gods have been anthropomorphized. Anthropomorphisms may stem from the discovered usefulness of using what one knows about oneself to predict others' behavior (Serpell 2003). In that way, anthropomorphism might have proved valuable to our human ancestors trying to anticipate the behavior of, for instance, predators by projecting human emotions and motivations onto them. The contemporary scientific attitude toward these attributions begins, interestingly, with the figure otherwise a radical innovator of our view of animals: Charles Darwin.

Characteristically, in his *The expression of emotions in man and animals*, Darwin was untroubled to claim that back-scratches "pleased" cats, to have seen birds faint when "terrified", and to assert that dogs "pretend" to fight during play (Darwin 1872/1979). His contemporary George Romanes followed suit, explaining his attributions by noting: "…we are justified in inferring particular mental states from particular bodily actions" (Romanes 1883). While a behaviorist backlash was immediate, by the mid-twentieth century a more nuanced approach was emerging, noting the value, for instance, in using anthropomorphic language to describe captive primate behavior (Hebb 1946). Similarly, observers have shown high agreement in qualitative assessments of pig expressions, an indication that even "subjective" descriptions may transcend subjects (Wemelsfelder et al. 2000). More recently, a new study of anthropomorphism itself has emerged—both assessing attributions empirically, and aiming to provide a psychological account of anthropomorphic beliefs.

Seminal work has shown that humans more readily anthropomorphize that which bears a real or superficial similarity to themselves, physically as well as behaviorally (Heider and Simmel 1944; Mitchell and Hamm 1996). Subjects more readily ascribe mental states to objects whose movements appear similar to typical human motion (Morewedge et al. 2007). Additionally, people more readily ascribe complex cognitive abilities to other primates as well as companion animal species, like dogs and cats, than to non-primates and non-pets (Eddy et al. 1993).

The relationship between dogs and humans is indeed special: while farm animals are described as "managed" or "handled" (Hemsworth 2003), for many dog owners the relationship is more familial than managerial, with some viewing their charges as "children" or "fur babies" (Greenebaum 2004). Many caretakers ask their companion dogs to participate in society as if they too were human, dressing them in clothing, staging pet "weddings", and maintaining social media accounts in their name. All are unnecessary for the dog's role as a social canid. Modern companion dogs are members of a new class readily viewed through an anthropomorphic lens.

The fluidity and ease with which dogs move alongside humans contributes to the anthropocentric light in which they are considered. In one study in which

people were asked to describe a scene between a dog and a person, subjects largely used "psychological" descriptors (Morris et al. 2000). These attributions, particularly that of "mindedness," carry into individuals' ordinary interactions with dogs. Owners' claims of their dogs' understanding and thought-processes are often transposed thoughts from their own heads. For instance, an owner explaining how, on a rainy day, her dogs will "just put one foot outside the door and then go over to where the cookies are kept [so as to say]: 'Well, technically we went out'" is not an unusual statement (Sanders 1993).

9.2.1 Testing of Anthropomorphisms

One line of work in our lab examines anthropomorphisms of animals. First, we ask whether attributions of secondary emotions made to dogs are well founded. Two studies are described below. Both emanate, in part, from evidence that the great majority of dog owners believes that their dogs experience secondary emotions: three-quarters (74 %) say that their dogs experience guilt; and 81 % believe their dogs experience jealousy (Morris et al. 2008). These attributions are of interest, as dogs' long association with and selection by humans suggests that they may display a rudimentary sense of morality (Bekoff 2004); similarly, the history of domestic dogs suggests that the species might have a highly developed sense of what is called "fairness" or even "justice" in primate literature (Brosnan 2013). Second, we describe research looking at the contribution of dog physical appearance to human anthropomorphizing.

9.2.1.1 Guilt

Attributing "guilt" to dogs has long standing: even the great animal observer Konrad Lorenz (1954) wrote of the dog's "bad conscience" on doing a misdeed. The claim is not simply that a dog looks guilty, but that he may feel guilty, having done something "wrong" or which breaks household rules (Sanders 1993). The attribution appears to be based on the recognizable "guilty look" of the dog, especially when this behavior is noticed around the time of an act which has been forbidden (or in the vicinity of evidence of that past act). The "guilty look", according to owner and behaviorist report, includes a combination of any of the following behaviors: avoiding eye contact (Darwin 1872/1979), rolling over, offering a paw (Lorenz 1954), retreating from the owner (Cheney and Seyfarth 2007; Whitely 2006), holding the tail low and head or ears back (McConnell 2006; de Waal 1997), tongue-flicking, freezing, and a low wag.

Thus, to test the connection of these behaviors associated with the guilty look (hereafter, *ABs*) to *actual guilt*—that is, a misdeed—a simple two-by-two design was used, where the appearance of ABs was the dependent variable (Horowitz 2009a). The experimenter recruited fourteen dog-owner dyads (subjects dogs: 6 m,

8 f; mean age 2:6 (range 0:8–9:0); 6 mongrels, 8 purebreds) and performed the experiment in their homes. The owners were told to instruct their dog not to eat a desired treat, and then the owners left the room. The dogs (videotaped throughout the owners' admonishment, absence, and later return) had the opportunity during the owners' absence to eat the forbidden treat.[1] When each owner returned to the room, she was told whether or not her dog "obeyed" the instruction, and to greet the dog if so, or respond with scolding if not. Each dyad participated in four trials, over which two conditions were varied: dog obedience and owner response. In the first condition, the subject either disobeyed (ate the treat) or obeyed (did not eat the treat). In the second condition, the owner was either informed that the dog had or had not eaten the treat, and thus responded to the dog by greeting or scolding, respectively.

Crucially, the report the owner received of the dog's behavior was not always a true report of the dog's behaviour. In two of four trials the owner was misinformed about the dog's behavior: told that the dog had obeyed when in fact the dog had eaten the treat, and told that the dog had disobeyed when he had not.

The subject dogs' behavior was coded from the videotape for number of ABs after owner return in each trial. There was no significant main effect of the dogs' obedience on the number of ABs ($F(1, 13) = 1.59$, $p = 0.23$, $r = 0.33$). This indicates that the rate of ABs was similar whether the dogs ate the treat or did not eat the treat: whether each dog was "guilty" or "not guilty" of violating his owner's command. There *was* a significant main effect of the response of the owner on ABs ($F(1, 13) = 29.22$, $p < .001$, $r = 0.83$). Scolding the dog led to significantly more ABs than greeting the dog, whether the dog had obeyed the owner's command or was guilty of violating the command. These two results indicate that ABs were a response to owner scolding more than to the dog's own actions. Interestingly, there was a significant interaction effect between the obedience trials and the owner's response ($F(1, 13) = 5.69$, $p = 0.03$, $r = 0.55$): scolding when the dog had not eaten the treat led to the most ABs.

From this study we can conclude that the hypothesis that ABs, the "guilty look", increase when a dog disobeys, is not borne out. Instead, *owner scolding behaviour* caused an increase in the guilty look. Thus, when the dogs were scolded but "innocent", the ABs they displayed were not a reflection of dog guilt but of an owner's *perception* of dog guilt. Since many ABs—such as rolling over, tucking the tail between the legs, and pressing the ears back—are submissive behaviors (Darwin 1872/1979), the ostensible "guilty" look may simply be a look of anticipation of, and attempted avoidance of, punishment (Horowitz 2009a).

In an extension of this experiment, research examined the anecdotal claim that dogs display a "guilty look" to non-scolding owners who are ignorant of any misdeed (Hecht et al. 2012). Thus the question is raised whether owners are

[1] Disobedience was assured by the treat being offered to the dog by the experimenter after the owner left the room, and obedience, by the treat's immediate removal. In pilot trials, no difference was seen in the dogs' behavior whether they ate the treat because it was provided by the experimenter or of their own accord.

misremembering (or selectively remembering) past incidents or whether it was the misdeed, not the scolding, that prompted dogs' "guilty look." Here, again, in a related paradigm, the rate of ABs did not rise with disobedience ($n = 52$; $z = -1.512$, $p = 0.131$). Additionally, owners could not determine based on dog behavior alone whether their dog had obeyed or not ($p = 0.623$).

Thus the attribution of an experience of "guilt" to dogs, based on the "guilty look", is unfounded, a pure anthropomorphism. Of course, these results do not indicate that domestic dogs *do not experience* guilt, only that the "guilty look" is not indication of it. Instead, humans misinterpret a learned or instinctive submissive response as one indicating much more awareness than we have evidence of. Importantly, this mis-attribution could be harmful to dogs if their owners have expectations that the dogs *do* understand rules, correct behavior, and so forth, and believe that dogs either willfully or neglectfully violate these rules.

9.2.1.2 Fairness

According to Morris et al. (2008), "jealousy" is the most-often attributed secondary emotion to dogs. Dogs express jealousy, owners report, when they observe more attention being given to someone else than to themselves. In other words, the attribution of "jealousy" is founded on the observation of the dog's noticing an *unfair distribution of attention*. Our lab next tackled whether in fact, a dog has a sense of "fairness". Certainly related phenomena, such as cooperation, also critical to moral experiences (Brosnan 2006; de Waal 1997), are likely to have been part of the evolutionary history of dogs. To go by the behavior of their relatives today, dogs' progenitors built and maintained intraspecific social relationships in part through cooperative interactions, such as when taking down large prey (Mech 1970; Schenkel 1967). Dogs cooperate with conspecifics—as during play (Bekoff 2004)—and attend to one another's behavior, even displaying evidence of social learning (Pongrácz et al. 2008; Slabbert et al. 1997). The dog-human relationship results, in part, from selection for cooperative behavior—most visibly, when dogs assist the blind or engage in other synchronous activities (Gácsi et al. 2009; Naderi et al. 2001).

Given dogs' sociability, ability to coordinate behavior and cooperate with humans and conspecifics, and ability to distinguish notable quantity differences (Ward and Smuts 2007; West and Young 2002), it is reasonable to inquire whether dogs are sensitive to unequal reward distribution.

An initial study by Range et al. (2009) investigated "inequity aversion" in dogs, a model used in studies of fairness with non-human primates. The primate research found that subjects stop participating in cooperative problem-solving tasks after observing a conspecific receive a better reward for the same effort expenditure (Brosnan and de Waal 2003). In this study of *disadvantageous* inequity aversion with dogs—wherein a subject receives less of some reward than another individual—two dogs sat next to one another and were asked to "give a paw" for a reward. When the subject dog was not rewarded for performing the

requested behavior, the subject stopped performing more quickly if the other dog continued to be rewarded than when the subject was alone (Range et al. 2009).

A sense of fairness, however involves more than changing one's behavior after being treated unfairly (disadvantageous inequity); it also involves changing one's behavior when others are treated unfairly (*advantageous* inequity).

While advantageous inequity is rare, even in non-human primates, our lab's investigation of inequity aversion in companion dogs included both these aspects (Horowitz 2012). The method was extrapolated from studies of justice in humans (Pritchard et al. 1972). In each trial, subject dogs (n = 38) received the same amount of reward, and the amount given to the control dog varied. Subject and control dogs approached and were familiarized with two trainers who offered different amounts of a reward: one provided both dogs with equal food quantities for performing the behavior "sit," and the second rewarded the dogs unequally, either over-rewarding (3 pieces of food) or under-rewarding (no pieces of food) the control dog. Subject dogs then chose which trainer to approach by themselves, a "fair" trainer or one of the "unfair" trainers.

In the under-rewarding trial, when the trainer gave the control dog less (no) food, subjects were equally likely to choose the fair (16; 48.5 %) and the unfair (17; 51.5 %) trainer ($c^2(1) = 0.03$, $p = 0.86$). But in the over-rewarding trial, where the trainer gave the control dog more food, subjects (25; 78.1 %) chose the unfair trainer over the fair ($c^2(1) = 10.13$, $p = 0.001$), a counter-intuitive result if dogs are concerned with fairness. Ultimately, dogs were less influenced by how they, or another dog, were treated—seeming to ignore the ethics of both advantageous and disadvantageous inequity aversion—and were instead more concerned with which trainer was doling out more food overall.

The research to date suggests that dogs do not consistently show sensitivity to disadvantageous inequitable situations and do not consistently attend to advantageous inequity. The concepts of *fairness*, or even *justice*, make more functional sense in description of cultures with societal norms and explicit rules, such as human culture. Dogs may be better described as *socially aware opportunists.* The question of dogs' experience of jealousy is outstanding, but this research indicates that the correlated behavior may simply be the combination of an attention to where resources are, and a frustration or excitement about attempting to secure them.

9.2.2 Physical Prompts to Anthropomorphisms

Not only the behaviors but also the anatomical—physical—features of dogs which prompt anthropomorphisms can be examined. More broadly, this kind of investigation is part of research on the relationship between physical traits of non-human animals and humans' preferences and attributions based upon them.

Humans value—and are often attracted to—objects which are similar to ourselves: the most favored—and well-protected—species have a decidedly human-like physical appearance and share a phylogenetic similarity to humans

Fig. 9.1 Stimuli with eyes smaller (*left*) and larger (*right*)

(DeKay and McClelland 1996; Kellert 1996). People are specifically interested in the way dogs look (Weiss et al. 2012), and dogs possess many of the elements which could make human-like attributions easy: large round eyes; distinct irises and visible sclera; discernible and flexible facial features; and the ability to approximate a smile, move limbs independently, and even cover or scratch one's face (Horowitz and Bekoff 2007). Value judgments and attributions to dogs are heavily influenced by dog appearance, which is not surprising given the recently proposed theory of anthropomorphic selection: "selection in favor of physical and behavioral traits that facilitate the attribution of human mental states to nonhumans" (Serpell 2003). Breed standards connect physical appearance and character attributions: for instance, the breed standard for the Great Pyrenees describes its expression as "elegant, intelligent and contemplative" (American Kennel Club 2013).

In our own lab we have investigated which specific dog physical qualities attract human attention (Hecht and Horowitz 2013). By presenting study participants with two nearly identical dog images, differing only in that one physical characteristic had been manipulated, we were able to determine people's avowed preference for particular physical attributes. Participants (n = 124) viewed the images for up to 15 s and selected their preferred image. Subjects showed a preference for some features of the "infant schema" (Lorenz 1950/1971), namely large eyes ($z = 3.5929$, $p < 0.001$) (Fig. 9.1) and a larger space between the eyes ($z = 4.986$, $p < 0.001$). They also showed a preference for the human-like attributes tested, colored irises ($z = 12.7583$, $p < 0.001$) and a distinct "smile" ($z = 5.4993$, $p < 0.001$) (Fig. 9.2). In other research, dog coat color and ear shape have been found to be associated with particular personality attributions (Fratkin and Baker 2013). For instance, an unfamiliar yellow-coated dog received higher ratings of agreeableness, conscientiousness and emotional stability than the same dog with a black coat. These studies demonstrate that as with dog behaviors, the contribution of elements of dog physical appearance to attributions made of them can be investigated empirically.

Fig. 9.2 Stimuli with no smile (*left*) and slight smile (*right*)

9.3 Anthropocentrism and Canid-Centrism

By contrast with owners, researchers of dogs, skilled in studying animal behavior, are generally quite sensitive to the possibility of anthropomorphizing their subjects. Study designs attempt to avoid making undue attributions. Some anthropocentric perspective is natural though, and quite common. Taking a step back from some now-familiar dog-cognition research can aid in seeing how insidious anthropocentrism can be.

For instance, by far the most common category of experiment with dogs examines their response to various human cues—such as facial expressions (Buttelmann and Tomasello 2013)—and especially behaviors—such as pointing (e.g., Soproni et al. 2002). While these studies appropriately recognize the salience, or significance, of humans in the dog's world, there are some limitations to their recognition of what the dog may perceive of the humans. The most straightforward limitation is in modality: is a visual cue likely to be the most salient cue for a species whose primary modality is olfactory? While the vision of the average dog allows him to see a pointing hand, might not the opening of the olfactory lode that is the human armpit be as or more informative? Questions also remain about exactly *what* the pointing gesture might mean for the dog. Is what we think of as a straightforward "point" an *informative* gesture to the dog, as commonly assumed, or a *command* (explored by Scheider et al. 2013)? The dog's interpretation might not match the human's label.

The above studies exemplify the kinds of missteps that can be made: by not considering the dog's *sensory abilities*, and by *labeling* a behavior (of human or dog) in a human way, instead of attempting to interpret dog behavior in a way sensitive to the dog's social and cognitive abilities. Disregarding, or ignorance of the different sensory abilities and constraints of non-human animals has been

surprisingly prevalent in animal science. For instance, for many years researchers assumed that aposematic coloration of some animals allowed predators to see the color—but as it turns out, many of these animals' predators are effectively color blind, and may be seeing color contrast only (Rivas and Burghardt 2002). Below we focus on elements of two studies which make *assumptions about sensory abilities*: about dog vision and olfaction. Then we describe components of three studies which *prematurely label* dog behavior with human-relevant terms, disadvantageous to clear interpretation of data. Finally, a series of studies on one topic shows how over time, research has evolved, improving sensitivity to the subject and improving reliability of results.

9.3.1 Assumptions About Sensory Abilities

Because their vision is reasonably good, the particulars of dogs' visual system is often neglected in research studies. For instance, interesting work showing that dogs are more likely to steal forbidden food in "the dark" than in a "lit" room dismisses the idea that dog vision is different than human vision out of hand (Kaminski et al. 2013). But research on canid behavior in natural environments provides good evidence that these species see well—better than humans do—in the dark: many are crepuscular or nocturnal foragers or hunters, and are most active in these hours (Sillero-Zubiri et al. 2004). If their behavior is not entirely due to seeing, which seems likely, it is at least done in hours which are not lit: as a result, "the dark" is not an uninformative environment for dogs. The anatomy of the dog retina makes it plain how dogs see differently at night than humans do: dogs have a tapetum lucidum, as well as a preponderance of rod cells, photoreceptor cells which fire at low light (Miller and Murphy 1995).

Certainly dog breeds vary in visual capacity (e.g. McGreevy et al. 2004). No breed information was given for the subjects of this experiment—but breed differences may very well explain why some subjects chose to steal food more often when the food was illuminated and the person was not, or when the person was illuminated and the food was not (Kaminski et al. 2013).

Notably, even research which tackles common anthropomorphisms, such is the claim that dogs act "heroically" to save owners who are drowning, in a fire, or otherwise in danger (Macpherson and Roberts 2006), is not immune to anthropocentrism. The overweening attribution that the researchers address is not that dogs have acted in a way so as to save their owners—they may indeed have—but that dogs act *with understanding of the situation and intent to assist*. The study explicitly tested this claim by setting up artificial emergency situations, such as an owner, accompanied her dog, conspiring with the experimenters to fake a heart attack or pretend to be trapped under an (actually lightweight) fallen bookcase. No dog acted to help his owner by notifying a bystander (Macpherson and Roberts 2006). While notable for taking on an anthropomorphism, even this study relies on a critical sensory assumption: that dogs cannot distinguish, by smell or other

means, a pretend heart attack from a real one—itself a claim which should be tested, not presumed, given the dog's impressive olfactory ability.

9.3.2 Premature Labeling

Comparative psychology research aims to discover the similarities, or dissimilarities, between the psychology of humans and non-human animals. Thus an argument might be made that, by starting with human cognitive capacity, any comparative psychological approach is inherently anthropocentric. However, not all such studies need be anthropomorphic: most research is careful to assess the behaviors of animals and humans in their respective contexts. For instance, while point- and gaze-following by children is part of a normally developing theory of mind, dogs' abilities to follow a point or gaze is not typically considered evidence that they are developing a human-like theory of mind.

Less careful has been research studying empathy, another human ability of interest to comparative psychologists. For instance, in one study interested in dogs' empathetic abilities, researchers measured subject dogs' responses to an experimenter or owner pretending to cry (Custance and Mayer 2012). While exposure to a (feigning) crying person may be a reasonable context for exploring empathy-like responses in human children, there is no a priori reason to believe that dogs would even be sensitive to *actual* crying, as the species does not cry. More apt, and less anthropomorphic, would be gauging the dogs' responses to an intraspecific "cry." Relevant vocalizations dogs produce include whimpers, whines, screams, and yelps (Tembrock 1976); the "isolation" bark is another candidate emotion-rich vocalization (Yin 2002). Furthermore, while human empathy may sometimes be demonstrated by a person's response to conspecific crying, "responding to crying" does not equal "existence of empathy." Neither does it for dogs.

At times, language from a human context is applied to the analysis of dog behavior in such a way that results rest on problematic data, and may interfere with an understanding of the behavior of the species. For instance, research on social play which uses terms of human games—"wins" and "loss"—to characterize kinds of dog behaviors, inevitably finds that some dogs "win" games and some "lose" games (Bauer and Smuts 2007). However, substantial research on social play of mammals, including, specifically, play of dogs, does not indicate that play bouts are resolved with "winners" or "losers," as in a competitive sports match. On the contrary, in ethological work, bouts are not defined by results but by specified play behaviors (Burghardt 2005; Fagen 1981; Rooney et al. 2000), and marked, in dogs, by the regular use of play signals (Bekoff 1972; Bekoff 1974; Fox 1978; Horowitz 2009b) (see also Bekoff, this volume). Conclusory assessments of a category of behavior are sometimes cultivated by a limited ethogram (the set of behaviors noted of relevance to the researchers). Such assessments can be avoided.

Finally, interesting research (discussed above) has demonstrated that dogs are averse to inequity, when they are the recipients of the inequity (Range et al. 2009).

In particular, dogs stopped "giving the paw" or "shaking", when no longer rewarded for the behavior, most quickly when a social partner continued to be rewarded. It is surely relevant that "giving the paw" is considered a "submissive" behavior by dogs (Lorenz 1954), and thus the experimental scenario is tinged with the dynamic of the social setting alone, regardless of the change in the dog's fortunes.

These anthropocentric tendencies can be overcome by appeal to the existing literature of dog ethology. At times improvement comes through running multiple iterations of an experiment. The methods used in the study of yawning behavior in dogs is one research topic which has improved through replication. The first studies used video recordings of owner yawns in presentation to dog subjects (Joly-Mascheroni et al. 2008; Harr et al. 2009) added recordings of dog yawns to the mix. Such an addition presumably helped account for the fact that while dogs can see video images, it is likely not the only salient sensory element of a presentation to the subjects. Silva et al. (2012) attempted to isolate the auditory component of yawn from the visual component, and also contrasted familiar and unfamiliar persons as stimuli for subject dogs. Here the importance of the yawner to the dog was acknowledged. At this point, the role of the yawn as stress modulator, as described by trainers (Rugaas 2006), was not yet discussed. Recently, though, two papers have investigated the correlation of contagious yawning and arousal levels (Buttner and Strasser 2014; Romero et al. 2013). Our understanding of dog yawning has substantively improved based on methodological refinements attending to *what the behavior is like for the dog*.

9.3.3 Umwelt

Happily, many dog studies do take a canid-centered view. Instead of assuming their subjects experience and perceive the world, and the experimental setting, just as humans do, this research attends to the difference between canid and human *umwelt*, the subjective or "self-world" of each individual and species (von Uexküll 1934/1957). Von Uexküll proposed that only through attending to each animal's perceptual ability and noting what is salient for the animal, could one begin to draw a non-biased picture of the animal's world. Differences in *umwelt* exist for individuals as well as across-species: "The best way to find out that no two human *Umwelten* are the same," he suggested, "is to have yourself led through unknown territory by someone familiar with it. Your guide unerringly follows a path that you cannot see."

Between humans and dogs, one profound difference is sensory: while humans are visual creatures, dogs are olfactory (see also Gadbois and Reeve, this volume). Dog noses house hundreds of millions more olfactory cells than humans' do, and their corresponding brain regions are much more developed relative to their visual areas than in humans (Lindsay 2000). Respiration and smelling occur via different flow paths within the nose (Craven et al. 2010), and side-nostril exhalation

diminishes odor habituation (Settles et al. 2003). As trainers of drug-, narcotics-, and explosives-detection dogs know, their sense of smell is clearly acute (e.g. Gazit and Terkel 2003; McCulloch et al. 2006).

Thus the dog *umwelt*, insofar as it can be approached, will include, at minimum, a perceptual world different than humans'. A handful of instances of research programs which are sensitive to their subject's *umwelt* follow. They serve as demonstration of the ways this sensitivity is manifest, and how complex it can be to take a non-human species' perspective into account in design and execution of experiments.

Acknowledging the relevance of olfaction for these subjects is perhaps the most obvious way to become more dog-centered in experimental design. It is also, however, non-obvious how to control and systematically vary olfactory stimuli in an ordinary experimental or naturalistic setting. Thus it is rarely pursued in dog behavior and cognition studies.[2] Exceptions exist: most have been driven by concerns that olfactory knowledge might explain the subject dogs' performance in experimental trials. Thus, the olfactory cues are controlled in an additional trial iteration to pursue that concern. For instance, early research in this field found that dogs' performance on invisible displacement tasks was not compromised when olfactory cues were masked (Gagnon and Doré 1992)—evidence that subjects were solving the tasks visually, as they had been designed. In addition, when exploring the response of dogs to a dog-shaped robot toy (the AIBO), researchers considered whether having a dog scent (from material lain in a puppy's sleeping box) on the toy would change the subjects' behavior (Kubinyi et al. 2004), although they did not consider the degradation of the odor over time. Relatedly, one study explicitly examined whether social responses to a child's dummy would be changed when its clothes were impregnated with the odor of a familiar or unfamiliar child (Millot 1994). Our own lab recently looked at whether dogs' visual discrimination of more or less food on plates (and selection of the former) (Prato-Previde et al. 2008) was matched by their olfactory discrimination of these quantities (Horowitz et al. 2013). It was not: dogs did not reliably choose a larger quantity of desired food when given olfactory cues alone. On the other hand, the subjects did attend more to the "larger" quantity (covered) plate, when presented to them. Thus, in this kind of experimental trial, measurement of subjects' *attention* conflicted with data of their plate *selection* (Horowitz et al. 2013). In all cases, the role of olfactory cues in explaining dogs' behavior was part of the studies' designs.

Finally, one study addressed whether olfactory cues were relevant in dogs' success at finding hidden food seemingly through following human pointing gestures (Szetei et al. 2003). While the authors found that dogs could follow either olfactory and visual cues, they also found subjects more willing to follow a human

[2] Putting aside, of course, the many studies of dogs as tracking dogs or explosives-, drug-, or disease-detection dogs. These research programs are highly relevant for an understanding not just of these working dogs, but also of the entire species. However, these programs do not arise from the cognitive and behavioral fields with which this chapter is concerned.

point when it conflicted with present olfactory information. This study is to be commended not only for attention to the dogs' perceptual experience of an experimental scenario, but also for revealing more information about the hierarchy of cues a dog follows. The "constraints of the social context"—i.e. a human-dog interaction—may trump the odor information available to dogs (Szetei et al. 2003). This phenomenon is a kind of behavioral version of Heisenberg's Uncertainty Principle: the very *presence* of an owner may change the dog's behavior. Dogs' problem-solving capacity may be reduced when the owner is present (Topál et al. 1997); and Clever-Hans-reminiscent cuing and errors can always occur whether an owner (or experimenter) is blinded to the experiment or not (Hauser et al. 2011).

Similarly, research examining dogs' behavior toward new and old objects, otherwise identical, highlights a characteristic of dogs that is highly relevant in dog cognition studies: the species' neophilia (Kaulfuß and Mills 2008). Other studies have examined whether dogs have a side bias (Miklósi 2007) or are subject to a recency effect (Horowitz et al. 2013; Tapp et al. 2003), either of which could partially explain subjects' behavior on a two-sided forced-choice test. Similarly, the effect of gender—especially over repeated presentations—is beginning to get some attention (Duranton et al. 2013). Individual differences have also been examined: Leonardi et al. (2012) developed a protocol testing a dog's ability to delay gratification, with training, via trading lower-quality food in mouth for an anticipated higher-quality food item. The authors rightly noted the importance of both individual variation and olfactory dominance. Prior to training, each individual's "hierarchy" of food preferences was noted. This was used in determining what was "low value" or "high value" for each subject. (Such is now also done in other paradigms—e.g. Kundey et al. 2010.) Similarly, given the difficulty in determining which food smelled the strongest for dogs, the authors also tested quantitative versions (more quantity) of a successive-exchange task, not just qualitative (higher-value food).

The above studies by no means serve as an exhaustive list of dog-centered research designs; however they give a good sampling of the manifestations of the approach in current dog cognition literature.

9.4 Conclusion

As common, and perhaps inevitable, as some anthropocentric perspective is in studying non-humans, including dogs, our research hints at two alternatives. First, through empirical investigation of anthropomorphisms made of dogs, it is clear that these attributions can be tested—and dismissed, if appropriate. Second, through an appreciation of the *umwelt* of the species, projects can be designed which are more dog-centered in approach. Often, observational and simple experimental practices can lend insight into the dog's *umwelt*, which can then be used in design of more *umwelt*-sensitive research. For instance, a fascinating question for non-human animal researchers is what kind of self-awareness, or understanding of self, animals have.

In our lab we are currently designing a protocol to study self-recognition in dogs by modifying the "mirror self-recognition" task as developed and refined (Gallup 1970; Reiss and Marino 2001) for dogs. While a mirror, which allows for self-examination, is a sensible apparatus in a task given to visually-dominant creatures, an *olfactory mirror* would be more appropriate for a dog (Horowitz 2009c). By testing what olfactory acuity an untrained dog has (Horowitz et al. 2013) and re-defining what object may play the role of "mirror" in a canid's life, this interesting question can be asking appropriately of dogs. It is fascinating, and important, to re-consider this most familiar species in a canid-centered, unfamiliar light.

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