What is unique about shared reality? Insights from a new comparison species

Angie M Johnston[1], Molly Byrne[2] and Laurie R Santos[1]

We introduce a new comparison species — domesticated dogs (*Canis familaris*) — that can shed light on the evolutionary origins of shared reality. Given that dogs share many basic building blocks of shared reality (e.g. representing others' perceptions, emotions, and behaviors) they provide an ideal species for pinpointing unique aspects of shared reality in humans. In particular, current research with dogs underscores two aspects of shared reality that may be special to humans. First, humans may be unique in our tendency to share reality *involuntarily*. Second, humans may be unique in the *extent* to which we share reality. Although both humans and dogs share reality in one-on-one interactions, only humans share reality at the more extensive group and cultural level.

Addresses
[1] Department of Psychology, Yale University, 2 Hillhouse Avenue, New Haven, CT 06520, USA
[2] Department of Psychology, Wesleyan University, 207 High Street, Middletown, CT 06459, USA

Corresponding author: Johnston, Angie M (angie.johnston@yale.edu)

Humans have a complex social world that is unrivaled by even our closest primate relatives. Recent work proposes one crucial aspect of human social cognition that may support our uniquely complex social world — shared reality, or the process by which individuals experience shared inner states (e.g. feelings and beliefs) with others (see [1], this issue, for an in-depth review of shared reality). Shared reality not only facilitates our ability to establish and maintain interpersonal relationships, but it also allows us to achieve a more reliable understanding of the world that is validated by others' experiences [e.g. 2,3]. Recent work exploring the developmental origins of shared reality has traced many of the earliest precursors of shared reality (e.g. gaze following) back to infancy (for a review, see [4]); however it remains unclear how shared reality evolved. One way to gain insight into this question is to take a comparative approach and pinpoint which aspects of shared reality are unique and which are shared across species.

In the sections that follow, we first introduce a new comparison species — domesticated dogs (*Canis familaris*) — that can help pinpoint unique aspects of shared reality in humans. Next, we review the common building blocks of shared reality that humans share with dogs, as well as the unique aspects of shared reality that humans do not share with dogs. Finally, we end with a brief discussion of what this work with dogs tells us about shared reality in humans.

What dogs can tell us

Dogs are an ideal species for investigating which aspects of shared reality are unique to humans because they share many basic aspects of social cognition that underpin shared reality. In contrast to other non-human species that lack human-like motivation to share inner states with others [e.g. 5,6], dogs are highly cued into the human social world [e.g. 7,8•]. By 6 weeks of age, dogs readily follow human social cues, such as pointing, even if these cues have never been trained [9]. Moreover, by several months of age, dogs can initiate communication with humans by 'looking back' and establishing eye contact [10]. Given that dogs so readily share many basic aspects of the human social world, they are an ideal species for pinpointing unique features of shared reality in humans.

Common building blocks of shared reality

At the most basic level, shared reality requires an understanding of and a motivation to pay attention to what other individuals perceive. Dogs — like humans — do seem to be sensitive to what people are looking at. When dogs see a person look toward an object, they tend to follow that persons gaze, particularly if signaled with communicative cues [e.g. 11,12]. There is also evidence that dogs recognize that looking toward an object leads — at least on some level — to experiencing it. For example, dogs are more likely to behave when a person is watching [e.g. 13•,14,15], suggesting that dogs recognize that seeing can lead to knowing. Dogs also seem to distinguish between who does and does not have information; dogs are more likely to follow information from a knowledgeable person who witnessed a treat being hidden than a guesser who did not [16,17]. These findings together demonstrate that dogs are tuned into others' visual experience, a critical building block of shared reality.

In addition to being proficient readers of others' perceptual experiences, dogs are also highly attuned to human emotions. When faced with an uncertain situation, dogs, like humans, socially reference with others [e.g. 18,19] and use human emotions to guide their behavior [20–22]. In addition, dogs are affected by the emotions of those around them. When dogs hear negative emotional sounds (e.g. crying) emitted by either humans or dogs, they reflect these negative states by whining, scratching, and panting [23]. Together these findings demonstrate that dogs readily represent and reflect the emotional states of others, as one might expect if dogs were representing a shared reality.

Dogs also have the capacity to coordinate actions with humans. When trained to imitate a humans actions using the 'Do-As-I-Do' method [e.g. 24–26], dogs readily imitate complex human action sequences, even after a 24-hour delay [25]. Dogs also successfully coordinate their actions with humans. One recent study demonstrated that dogs can work together with humans to achieve a mutual goal [27] and can provide help to humans when actively solicited [28]. Thus, dogs can coordinate with humans in cooperative contexts, just as a shared reality account might predict.

Dogs also seem to be motivated to share and communicate information that would influence their shared reality with humans. One of the most well-established findings in canine cognition is that dogs look back to humans whenever they face a challenging situation [e.g. 10,29,30]. Crucially, it appears that this looking back behavior is referential [e.g. 31,32•], suggesting that dogs are motivated to actively initiate communication about something in the world. In this way, dogs appear to share a human-like motivation to initiate communication and thus a desire to share some part of their experience with humans, both of which are crucial components of shared reality.

Together, these findings demonstrate that dogs share many of the basic building blocks of shared reality with humans. Dogs not only recognize human perceptions and emotions, but they are also motivated to share reality with humans through their communicative acts. Thus, this work suggests that humans do not uniquely possess some of the most important building blocks of shared reality.

Human unique aspects of shared reality
Shared reality as an involuntary process
Although dogs demonstrate many basic building blocks of shared reality, there are two crucial ways in which dogs' ability to connect with humans differs from a truly human-like shared reality. The first concerns the *involuntary* nature of shared reality. Much work suggests that humans have no control over sharing reality with others and appear to share in others' reality often without intent

to do so or even conscious awareness (e.g. in the saying-is-believing paradigm [33,34]). In contrast, although dogs are capable of understanding aspects of a humans experiences, they appear to control when they do and do not take on others' actions. For example, even though dogs easily imitate human actions [e.g. 24–26], they do not prioritize imitation in the same way as human children. When human children watch someone demonstrate how to solve a puzzle, they will reproduce — or overimitate — the demonstrators actions exactly, even if some of the steps are unnecessary [e.g. 35,36]. In contrast, dogs do not overimitate; instead they opt to find more efficient solutions on their own [37]. In fact, dogs only privilege human demonstration over their own observations if they interpret the demonstration as a command [e.g. 38,39•]. These findings underscore a crucial difference in the way that dogs and humans share the experience of others. Although both dogs and children are capable of imitating human actions [e.g. 24–26], dogs do not involuntarily privilege others' actions over their own experience in the same way as humans do.

Shared reality at the group level
A second way that dogs' ability to share experiences differs from human shared reality concerns *how and with whom reality is shared*. Humans do not need to be in a direct one-on-one interaction with someone to share their reality. On the contrary, human shared reality manifests in many broader aspects of society, such as cultural norms and laws [e.g. 2] that exist between people who may never have met. This aspect of human shared reality emerges quite early; indeed, even young children react with guilt when they know they have violated a shared norm even if no one was watching [e.g. 40,41]. In contrast, dogs often struggle to conform to rules of behavior in the absence of direct surveillance [e.g. 13•,14]. Thus, dogs do not share reality to the same extent as humans, as they do not internalize cultural rules and norms in the same way as humans.

Similarly, while dogs seem to share experiences with people one-on-one, they do not appear to share reality with others in third-party contexts. Even from infancy, humans glean information about others' experience by 'eavesdropping' on third-party interactions. For example, human infants form opinions about who is nice and mean based on indirect interactions between third parties [e.g. 42]. In contrast, dogs do not learn information through eavesdropping in the same way as human infants. Although initial work hinted that dogs could glean information about who was nice and mean from indirect third-party interactions [43,44], more recent work with additional control conditions suggests that this is not the case [45,46,47•]. For example, one recent study showed that dogs are able to learn who is nice and mean when directly interacting with humans, but they are unable to extract this information in third-party contexts as a human would