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Training differences predict dogs' (*Canis lupus familiaris*) preferences for prosocial others

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Abstract

Humans evaluate other agents' behavior on a variety of different dimensions, including morally, from a very early age. For example, human infants as young as 6-months old prefer prosocial over antisocial others and demonstrate negative evaluations of antisocial others in a variety of paradigms (Hamlin et al. in Nature 450(7169):557, 2007; Dev Sci 13(6):923–929, 2010; Proc Natl Acad Sci 108(50):19931–19936, 2011). While these tendencies are well documented in the human species, less is known about whether similar preference emerge in non-human animals. Here, we explore this question by testing prosocial preferences in one non-human species: the domestic dog (*Canis lupus familiaris*). Given the ubiquity of dog–human social interactions, it is possible that dogs display human-like social evaluation tendencies. Unfortunately, prior research examining social evaluation in dogs has produced mixed results. To assess whether differences in methodology or training differences account for these contrasting results, we tested two samples of dogs with different training histories on an identical social evaluation task. Trained agility dogs approached a prosocial actor significantly more often than an antisocial actor, while untrained pet dogs showed no preference for either actor. These differences across dogs with different training histories suggest that while dogs may demonstrate preferences for prosocial others in some contexts, their social evaluation abilities are less flexible and less robust compared to those of humans.

Keywords Canine cognition · Social evaluation · Prosocial behavior

Introduction

To successfully navigate the social world, humans must rapidly form representations of others' behavior along many dimensions (Winter and Uleman 1984; Ambady and Rosenthal 1992). One application of this human social evaluation is the ability to infer which individuals will behave prosocially in future interactions (by helping or sharing resources), and which individuals might behave antisocially (by hindering or withholding resources). The ability to socially evaluate others based on observed behavior appears to be deeply rooted in human social cognition, as the tendency to prefer prosocial others compared to antisocial others emerges early in human development (Hamlin et al. 2007, 2010, 2011). In a series of classic studies, Hamlin and colleagues presented infants with puppet shows in which a protagonist puppet attempted to reach the top of a hill, while other puppets (helping, hindering, or neutral puppets) influenced the outcome in some capacity. Infants saw cases in which a helping puppet propelled the primary puppet up to the top of the hill, a hindering puppet pushed the primary puppet down to the bottom of the hill, or a neutral puppet moved along the hill but did not influence the primary puppet's attempt to reach the top of the hill. After observing these events, infants were asked to choose between two of the influencing puppets. Six and 10-month-old infants chose the helping puppet significantly more often than both the hindering puppet and the neutral puppet (Hamlin et al. 2007, 2010). Follow-up work has shown that the tendency for young infants to prefer prosocial others over antisocial others occurs in a variety of contexts (Hamlin 2014), and researchers have now documented infants' negative

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evaluations of antisocial agents in a variety of experimental paradigms (Hamlin et al. 2011). These results suggest that social evaluative abilities in humans emerge early in life, and that they are highly robust and flexible.

Given the ubiquity of social evaluation in humans, some comparative researchers have wondered about the evolutionary origins of this capacity. If the tendency to prefer prosocial to antisocial others has adaptive significance, then humans' closest genetic relatives—non-human primates—may share this ability. Previous research studying this question has shown that nonhuman primate social evaluative tendencies appear to differ from those of humans, with nonhuman primates only preferring prosocial humans in certain contexts (Russell et al. 2008; Subiaul et al. 2008; Anderson et al. 2013a, b; Krupenye and Hare 2018). For example, in a helping paradigm in which a human actor needed assistance to open a container, capuchin monkeys preferred to accept food from an actor who remained neutral (neither helping nor hindering) rather than an antisocial actor who refused to help the original actor open the container (Anderson et al. 2013a). However, capuchins did not exhibit a preference between a prosocial actor, who helped open the container, and a neutral actor. This result suggests that in the context of helping behavior capuchin monkeys may possess a negativity bias but not a positivity bias. Capuchin monkeys also seem to socially evaluate humans on the basis of reciprocity, demonstrating a preference for actors who reciprocated an exchange of items with another actor over actors who failed to reciprocate or only partially reciprocated the exchange (Anderson et al. 2013b). Other studies have explored similar questions in apes. Russell et al. (2008) presented apes with a food sharing task in which subjects watched a prosocial actor give grapes to a human beggar and an antisocial actor refuse to give grapes to the beggar. They found that chimpanzees spent more time near the prosocial actor compared to the antisocial actor, and spent progressively less time near the antisocial actor as trials progressed (Russell et al. 2008). However, this preference only occurred after repeated exposure to the human actors. Bonobos, gorillas, and orangutans did not show a preference for either actor in this task (Russell et al. 2008). In a similar food sharing tasks, Subiaul et al. (2008) found that chimpanzees initially did not show a preference for either the prosocial nor the antisocial actor even though four of the seven subjects developed a preference for the prosocial actor after repeated exposure to the actors' behaviors. Of these four chimps, three preferred a prosocial actor over an antisocial actor on the first trial of a follow-up experiment featuring a conspecific beggar rather than a human beggar. In contrast to this somewhat positive evidence for human-like social evaluation in chimpanzees, Krupenye and Hare (2018) found that in a helping paradigm, bonobos preferred antisocial hinderers over prosocial helpers. This represents a stark contrast to human infants' preference for helpers over hinderers (Hamlin et al. 2007, 2010, 2011).

Taken together, this work suggests that nonhuman primate social evaluative tendencies may differ from the clear-cut preference humans exhibit toward prosocial others. However, it is worth noting that primate subjects in these studies evaluated humans and animated agents, but not conspecifics. It is possible then, that nonhuman primates may demonstrate a more robust preference for prosocial conspecifics over antisocial conspecifics. Indeed, social evaluation of human agents may depend on extensive input with human social behavior. If this is the case, it's likely that a species with more social experience with humans may possess social evaluative skills that more closely resemble those of humans.

The domestic dog represents an ideal species to examine this question. Given dogs' life histories alongside humans, it is plausible that they might possess sufficient input to socially evaluate humans. Dogs may also have acquired sensitivity to human prosociality as a product of domestication; dogs who could identify prosocial humans may have had increased access to resources and protection from environmental threats. Thus, the tendency to seek out prosocial humans may have been particularly evolutionarily adaptive for dogs.

Unfortunately, previous research assessing dogs' ability to socially evaluate humans has at least to date yielded rather mixed results (see review in Abdai and Miklósi 2016). Some studies to date have found that dogs prefer prosocial over antisocial humans (Kundey et al. 2011; Carballo et al. 2015; Chijiiwa et al. 2015; Anderson et al. 2017), whereas others observed no significant prosocial preferences (Marshall-Pescini et al. 2011; Nitzschner et al. 2012; Freidin et al. 2013; Nitzschner et al. 2014; McAuliffe et al. 2019, see Table 1). To understand this mixed pattern, it is worth more closely examining the dissimilarities between these published studies; indeed, a closer look at the published work to date suggests that differences in dogs' performance on these studies may be due to dissimilarities in the methods used in these experiments as well as the dog populations chosen for testing.

The set of studies exploring dogs' social evaluations to date have relied on a number different methodologies for testing social evaluation, and thus it is possible that differences between the methods of these studies may account for the observed differences in performance. One methodological factor that might impact dogs' ability to socially evaluate humans is the type of exposure to prosocial and antisocial humans (direct vs. indirect or first-party vs. third-party experience). Previous work has shown that dogs prefer to interact with an actor who pet them and attended to them compared to an actor who ignored them, suggesting dogs prefer attentive humans to inattentive humans in a first-party context. (Nitzschner et al. 2012). Yet after watching attentive and

Table 1 Summary of previous research on canine social evaluation

Study	Context of interaction	Type of experience	Actor identity	Recipient identity	Result
Nitzschner et al. (2012)	Attending vs. ignoring	Direct and indirect	Unfamiliar humans	Self (direct) or conspecific (indirect)	After direct experience, dogs preferred the attentive human. After indirect experience, dogs showed no preference
Kundey et al. (2011)	Food sharing	Indirect	Unfamiliar humans	Unfamiliar human	Dogs preferred the prosocial actor over the antisocial actor
Marshall-Pescini et al. (2011)	Food sharing	Indirect	Unfamiliar humans	Unfamiliar human	Dogs preferred the prosocial actor, but not if the actors switched places before dogs made their choices
Nitzschner et al. (2014)	Food sharing	Indirect	Unfamiliar humans	Unfamiliar human	Dogs preferred the prosocial actor, but not if the actors switched places before dogs made their choices
Freidin et al. (2013)	Food sharing	Indirect	Unfamiliar humans	Unfamiliar human	Dogs preferred the prosocial actor, but only in the presence of other social cues such as body language and vocal timbre. Dogs did not show a preference when the actors switched places
Carballo et al. (2015)	Food sharing	Direct	Unfamiliar humans	Self	Dogs preferred the prosocial actor over the antisocial actor when the actors were of different genders but not when the actors were gender matched
Chijiiwa et al. (2015)	Helping	Indirect	Unfamiliar humans	Dog's owner	Dogs preferred the neutral actor over the antisocial actor, but did not have a preference between the neutral actor and the prosocial actor. The prosocial and antisocial actors were not compared directly
McAuliffe et al. (2019)	Helping	Indirect	Novel animate shapes	A separate animate shape	Dogs did not show a preference between the prosocial shape and the antisocial shape

A comparison of the methodologies used in previous work reveals differences in the context of interaction, type of experience dogs received, and identities of others involved in the study

inattentive humans interact with a conspecific, dogs did not have a preference between the two humans, indicating that this preference does not generalize to third-party contexts. While the operationalization of prosociality and antisociality in this study differ from the sharing and helping paradigms used in experiments nonhuman primates, this finding provides insight into the role of perspective in canine social evaluation.

Another methodological factor that might impact social evaluation tendencies is the context of the social interaction. Some experiments have tested dogs' social evaluation by adopting food sharing paradigms similar to those used with nonhuman primates (Russell et al. 2008; Subiaul et al. 2008). Kundey et al. (2011) presented dogs with a food sharing paradigm in which they watched a prosocial actor give food to a human beggar and an antisocial actor refuse to share with the beggar. Dogs preferred to interact with the prosocial actor compared to the antisocial actor, even when the actors were substituted for inanimate objects. However, Abdai and Miklósi (2016) suggest that this result may stem from dogs simply attending more closely to a place where they saw a successful rather than unsuccessful food exchange. In a similar food sharing paradigm, Marshall-Pescini et al. (2011) report a similar preference for prosocial over antisocial actors but note that dogs chose between the actors at chance levels when the actors switched sides before dogs made their choice. This supports the idea the actors' position may carry more salience than their degree of prosociality. Nitzschner et al. (2014) found a similar effect of spatial position in a food sharing paradigm, as dogs preferred prosocial actors over antisocial actors only if they did not switch sides prior to dogs making their choice. Freidin et al. (2013) also examined the types of information dogs need to socially evaluate humans and found that dogs preferred prosocial to antisocial actors in a food sharing paradigm, but that this preference depended on the presence of social cues such as body language and verbal reactions. As in other studies (Marshall-Pescini et al. 2011; Nitzschner et al. 2014), this preference for prosocial humans also disappeared when the actors switched sides before dogs made their choice. Taken together, these papers suggest that dogs may demonstrate a preference for prosocial humans compared to antisocial humans in a food sharing context, but this preference may depend on the presence of other cues including consistent spatial positioning.

Dogs' ability to visually discriminate the human agents in these studies may also impact their social evaluative skills. Carballo et al. (2015) presented dogs with a variation of previous food sharing paradigms. In this paradigm, a prosocial actor pointed toward hidden food and allowed the dog to eat it, while an antisocial actor pointed toward the food but ate it before the dog could do so. In one condition, the prosocial and antisocial actors were gender matched, while in another condition the actors were of different genders. Dogs showed no preference between the actors when they were gender-matched, but preferred the prosocial actor when the actors were of different genders. This data suggest that dogs do prefer prosocial over antisocial humans, but their ability to visually discriminate between actors may limit dogs' ability to demonstrate this preference in some experimental contexts.

While most studies on canine social evaluation utilize food sharing paradigms, Chijiiwa et al. (2015) presented dogs with a helping paradigm in which their owner attempted to open a container. A prosocial actor assisted the owner, or an antisocial actor refused to help. A neutral actor sat next to the owner during this phase of the experiment. Dogs then choose between the neutral actor and either the antisocial or prosocial actor. Dogs preferred the neutral actor to the antisocial actor, but did not have a preference between the neutral actor and the prosocial actor. This result suggests that in a third-party helping context, dogs may possess a negativity bias but not a positivity bias. It is important to note that the recipient of the actions in this study was the dog's owner. Dogs may display different social evaluation tendencies in response to seeing their owner helped or ignored compared to seeing the same actions directed to an unfamiliar human. This study did not compare prosocial and antisocial actors directly.

A final methodological difference concerns the type of social agent dogs evaluate in studies to date. For example, it is possible dogs' social evaluation skills might be limited to evaluations of human agents. Recent research tested dogs on the hill paradigm from Hamlin et al. (2007, 2010); dogs watched events consisting of a helping shape propelling a second shape up a hill and a hindering shape push that shape down the hill. After watching these events, dogs did not display a preference between the helpings and hindering shapes (McAuliffe et al. 2019). This result suggests that dogs' social evaluation abilities may not extend to animated characters.

Taken together, previous research on social evaluation in domestic dogs does not clearly indicate whether dogs prefer prosocial to antisocial humans in large part because different methodologies may be the reason behind the found across various studies (Table 1 summarizes the key methodology differences in previous work). From the context of the interaction (interaction, food sharing, or helping), to dogs' role in the interaction (indirect, third-party experience, or direct, first-party experience), to the identity of the actors involved in the study (unfamiliar humans, the dog's owner, shapes) to the subtle social cues given by the human actors (e.g., body language, verbal responses), there are a number of specific methodological details that may impact dogs' ability to socially evaluate humans.

But there is also a second reason why dogs may show such varied performance in social evaluation tasks to date. It is possible that differences in dogs' training backgrounds

rather than methodological differences, account for the contrasting results seen in previous work. Under this view, dogs tested in previous studies may differ in their ability to socially evaluate humans due to differences in their training and life histories. Previous studies on dogs' social evaluation to date took place across three continents (Europe, Asia, and North America), and differences in dogs' relationship to humans in various cultures may account for differences in social evaluation ability based on geographic location. Even within a given culture, variation in dogs' training histories may introduce additional variance. Because training often involves closely attending to humans, highly trained dogs may possess elevated capacities for social evaluation.

While precise information about dogs' training history in social evaluation tasks is not available in previously published papers, other canine research suggests that can impact dogs' cognitive abilities in other contexts. For instance, trained "gun dogs" (dogs trained for hunting) outperformed untrained pet dogs in following human pointing cues (McKinley and Sambrook 2000), and clicker trained dogs learned to solve a puzzle faster and made fewer errors than untrained dogs (Osthaus et al. 2005). In addition, Marshall-Pescini et al. (2008) found that dogs trained for a variety of purposes, including agility dogs, solved an opened a puzzle box more frequently than untrained dogs.

Previous research on training differences also suggests that highly trained dogs may attend more closely to humans compared to untrained dogs. Schutzhaund trained dogs looked at their owners more frequently than untrained dogs when walking on a leash (Bentosela et al. 2008). Agility training in particular may be associated with increased attentiveness to humans, as agility dogs looked longer at their owner in an unsolvable task compared to both untrained dogs and search and rescue dogs (Marshall-Pescini et al. 2009). Based on this previous work in other domains, it is plausible that highly trained dogs, and agility dogs in particular, may display elevated capacities to understand human social behavior relative to dogs with different training histories.

The present study aims to assess whether methodological versus training differences explain variation in results across dog social evaluation studies. To answer this question, we held methodology constant and compared subjects with vastly different training experience. Specifically, we tested two distinct populations of dogs with contrasting training histories using an identical method. Both samples were tested on a helping paradigm in which dogs received third-party (indirect) experience about unfamiliar humans. We chose this collection of variables because it encompasses components of many of the previously published studies; demonstrations of helping (Chijiiwa et al. 2015), the use of indirect, third-party experience (Kundey et al. 2011; Marshall-Pescini et al. 2011; Freidin et al. 2013; Nitzschner et al. 2014; Carballo et al. 2015; Chijiiwa et al. 2015; McAuliffe et al. 2019) and unfamiliar humans (Nitzschner et al. 2012; Kundey et al. 2011; Marshall-Pescini et al. 2011; Fredin et al. 2013; Nitzschner et al. 2014; Carballo et al. 2015). By incorporating methodological features from previously published studies, we allow for a meaningful population comparison by testing two samples of dogs using the exact same method.

If both dog groups perform similarly on the social evaluation task, this may suggest that methodology differences explain the lack of definitive results in previous research. Conversely, if dogs from our two samples perform differently on the task, this may suggest that population differences, rather than methodology differences may explain the results of this study and previous research.

Method

Participants

We tested 18 highly trained agility recruited at the 2018 Kentuckiana Dog Show (seven females; mean age 5.64; standard deviation 3.37; range 1–11.5). This agility trained sample consisted of seven herding dogs, five terriers, three sporting dogs, two toy breeds, and one hound. We tested dogs after they completed their agility heats in an enclosed tent outside of the agility ring as to avoid distracting visual and auditory stimuli.

We also tested 20 untrained pet dogs from the greater New Haven, Connecticut area recruited from a pre-existing database of dog participants at the Canine Cognition Center at Yale (13 females; mean age 6.84; standard deviation 4.32; range 1.5–18.6. We tested only untrained dogs, specifically ones whose owners reported had not received any formal training of any form. This untrained sample consisted of one herding dog, three terriers, five sporting dogs, one toy breed, two working dogs, and eight mixed breed dogs. Untrained pet dogs were tested in a dedicated lab space on campus.

Both dog samples participated in an identical procedure with only a few minor exceptions. As mentioned, testing took place in a tent for agility dogs and in a lab testing room for pet dogs. Similarly, most of the untrained pet dogs in our sample ($N = 18$) had participated in previous studies, while all 18 agility dogs participated in a study for the first time. We used the same primary experimenter (ZS) for both samples, but used two different sets of actors.

Procedure

Dogs watched a series of interactions between a male experimenter (E1) and two female actors (E2 and E3) who performed as a helper and a hinderer. E1 stood inside of a fenced-in area positioned between two tray tables which held clipboards,

while E2 and E3 stood in opposite corners of the testing area. Each social interaction began with E1 reaching for one of the clipboards. After 5 s of reaching, the actor positioned on the side of the reach approached the clipboard and performed her social interaction based on her role (helper or hinderer). The helper handed the clipboard to E1 and said, "here you go" in a neutral timbre, and the hinderer pulled the clipboard farther away from E1 and said, "that's mine." also in a neutral timbre. E1 responded to the helper by saying, "yay," and to the hinderer by saying, "oh." After this response, E1 left the testing area for 5 s before returning and reaching for the opposite clipboard. This process repeated until both the helper and hinderer performed her action three times, for a total of six social interactions.

After these interactions, E1 left the testing area once more, this time remaining outside for the duration of the experiment. The helper and hinderer sat down and extended their hands toward the dog with a food reward while maintaining a neutral gaze. The handler (each dog's owner) then turned the dog around, such that they faced E3 and E3, and dropped the leash allowing the dog to approach one of the actors. We recorded which actor the dog initially approached. Dogs who did not approach either actor within 60 s ($N=1$) were excluded. The order of the social interactions and the role of the actors were counterbalanced across dogs.

Results

A two-tailed binomial test revealed that agility dogs initially approached the helper significantly more often than the hinderer (% of dogs approaching the helper: 88.24%, $p=0.002$). However, pet dogs did not show this preference. Pet dogs approached each actor with equal frequency (% of dogs approaching the helper: 50%, $p=1.00$). A Fisher's exact test revealed a significant population difference such that agility dogs initially approached the helper significantly more often than pet dogs ($p=0.017$). Figure 1 sumarizes initial approach choices.

Neither agility dogs nor pet dogs showed a significant preference for either of the two actors independent of their role, (two-tailed binomial test: Agility—actor 1: 58.82%, $p=0.063$; Pet—actor 1: 50%, $p=1.00$), and there was not a significant difference between agility and pet dogs in their preferences between the two actors (Fisher's exact test: $p=0.743$).

Discussion

Trained agility dogs, but not untrained pet dogs, preferred prosocial to antisocial humans in a third-party helping context. Trained agility dogs initially approached a prosocial

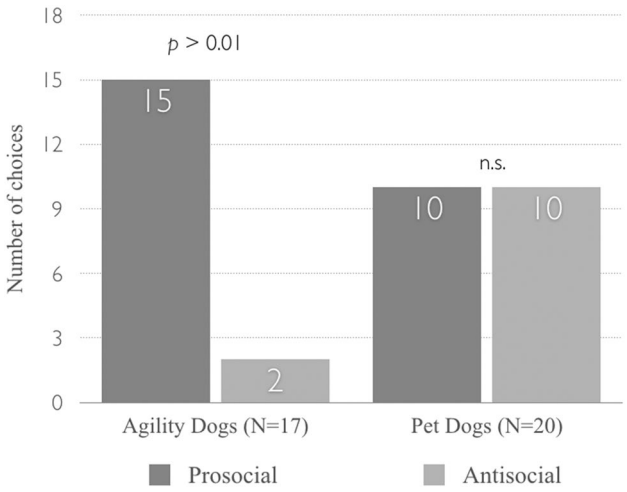

Fig. 1 Initial approach choices. Agility dogs initially approached the prosocial actor significantly more often than the antisocial actor ($p>0.01$). Pet dogs approached the two actors with equal frequency ($p=1$)

actor (helper) more frequently than from an antisocial actor (hinderer). Pet dogs in the current study, however, approached and accepted treats from the two actors with equal frequency, suggesting that subjects from this population failed to socially evaluate humans. Because dogs from both samples were tested using an identical method, the significant difference in their performance on this task suggests that training and life experiences may effect a dog's social evaluation ability. Our findings therefore suggest that mixed results in previous canine social evaluation studies may be due to training differences, rather than methodology differences.

Our results fit with previous work demonstrating that training shapes dogs' ability to understand human social behavior in other contexts (McKinley and Sambrook 2000; Osthaus et al. 2005; Bentosela et al. 2008; Gaunet 2008; Marshall-Pescini et al. 2008; Marshall-Pescini et al. 2009). As in previous research, trained dogs outperformed untrained dogs on a task involving human social cues. Our results support the finding that agility dogs, in particular, may possess elevated sensitivity to human social behavior compared to untrained dogs (Marshall-Pescini et al. 2009).

But how and why does agility training—and potentially other forms of training—effect dogs' preferences for prosocial others, as we observed in this study? One possibility is that all dogs have the potential to sociality evaluate humans with the right experience, but only trained dogs receive the experiences develop this capacity and thus demonstrate a preference for the prosocial actor. Under this view, trained dogs acquire a sensitivity to human social behavior through the training process and develop an elevated ability to evaluate humans relative to untrained dogs. In support of this

view, many dog training practices require dogs to attend to human social cues. This elevated attentiveness to human social cues generally may extend to human social interactions as well, and thus result in an elevated ability to discriminate between observed prosocial and antisocial behavior. For example, successfully evaluating the actors in our social evaluation task required dogs to represent the primary experimenter's goal of reaching the clipboard, as well as the helper and hinderer's intentions. In short, training may equip dogs with the cognitive skillset needed to pay attention to human actions generally, which allowed our trained dogs to discriminate between the two actors, and thus, demonstrate a preference for the prosocial actor.

A second possibility, though, is that training does not enable social evaluation skills, but rather simply improves dogs' performance in using these cues in experimental settings. Under this view, all dogs possess the cognitive skillset needed to discriminate between the prosocial and antisocial actors, but training enables dogs to demonstrate a preference between the two actors in an experimental setting. That is, both trained and untrained dogs may be able to discriminate between the two actors, but untrained dogs might lack the inhibitory control needed to preferentially approach the prosocial actor. Training, then, might enhance agility dogs' inhibitory control resulting in an observable preference in our paradigm. If this explanation were correct, then one might expect our untrained dogs to discriminate between the prosocial and antisocial actors using more subtle dependent measures than explicit choice. One way to assess whether dogs could discriminate between the two actors is to compare the duration of time that dogs looked at the two actors during the prosocial and antisocial demonstration. If dogs look at one experimenter significantly longer than the other, this would suggest that dogs detect a behavioral difference between the two actors. Indeed, a post hoc analysis revealed that during the stimulus presentation portion of the experiment, untrained dogs looked at the hinderer ($M = 12.57$ s SD 6.72) significantly longer than they looked at the helper ($M = 8.77$ s SD 3.77) $t\,(19) = 2.24$, $p = 0.037$. This suggests that the untrained dogs were able to distinguish between the prosocial and antisocial actors, yet they approached the actors with equal frequency. Unfortunately, limitations of camera angles in our agility dog testing space did not permit a looking time analysis for the trained agility dogs. However, the presence of a significant preference for the prosocial actor in the initial approach variable suggests that the agility dogs also distinguished between the two actors.

A third possibility for the performance difference we observed concerns the kind of dogs who succeed in a competitive agility setting. It is possible that in order to successfully participate in agility training, dogs must possess a high aptitude for reasoning about human behavior, and thus, have the capacity to socially evaluate humans. Dogs who either do not participate in this rigorous training or fail to succeed in their training (such that they ultimately do not compete in agility competitions) may lack this capacity for reasoning about human behavior and socially evaluating humans. Under this view, we would expect to replicate this pattern of performance we observed in our agility subjects in other canine samples that involve rigorous competition and training.

Finally, it is possible that a preference for prosocial others in dogs is an entirely learned skill, one that's distinct from dogs' domestication history. Trained dogs like the ones we tested may simply learn to seek prosocial rather than antisocial humans as a product of frequent exposure to human social interactions during the training process. If so, we might expect that even non-domesticated species with adequate exposure to human social interactions would perform similarly to the agility dogs in this task. Future research could explore this possibility by testing non-domesticated canid species with high levels of exposure to humans such as hand-reared wolves tested on a similar task.

Although the current study is not currently able to fully distinguish between these alternatives, our post hoc finding that untrained dogs looked at the hinderer significantly longer than the helper suggests that untrained dogs can discriminate between the two actors. This pattern of results hints that the differences between samples may be more related to our second task-specific performance explanation than to issues related to competence or capacity for social evaluations or a learned behavior. Future work should strive to distinguish between these explanations by incorporating additional measures like looking preferences that may elucidate dogs' ability to distinguish between the two actors. Further, exploring differences in inhibitory control across dogs with varying levels of training may enable a more robust understanding of the mechanisms underlying this difference in task-specific performance.

Although we must remain agnostic about whether training has increased dogs' capacity for social evaluation versus their performance on our task, the difference we observed between trained and untrained dogs raises another important issue: why is training having an effect on dogs' performance? More specifically, what components of agility training in particular might explain the observed difference? It is possible that dogs who regularly compete in dog shows are more experienced at performing in a variety of environments compared to dogs without this competition background. Thus, competing agility dogs may have been more comfortable in the testing environment enabling them to focus on the task to a greater extent compared to the untrained dogs. Further, during the process of training for and participating in agility competitions, dogs may become accustomed to predictable patterns of behavior from humans (e.g., commands consistently followed by rewards). It is possible that

this tendency to anticipate repetition of actions enabled the agility dogs to predict that a human who behaved prosocially in the demonstration would also do so in the test trial. Untrained dogs who have not been exposed to numerous repetitions of human behavior may not infer the same predictability of the actors' actions in the experiment. Thus, even if the untrained dogs could distinguish between the two actors, they may have been less likely to infer that the actors' past behavior would predict their future behavior. This difference in exposure to the types of behavioral repetition found in agility dog training may explain the absence of a preference between actors for untrained dogs and the strong preference for the prosocial actor for the trained dogs.

One key limitation of the present study arises from the lack of training standardization among the agility dogs in our sample. Although every dog in our sample was trained to perform the same task (competing in agility competitions), we had little information about how exactly each dog was trained. Thus, future research should sample dog populations with more standardized training backgrounds to isolate the specific components of training that support social evaluation. It is possible that various types of training may support the development of different types of cognition [see Duranton and Horowitz (2019) for an example of specific training practices impacting dogs' judgment biases], and thus that dogs trained for different tasks or using different techniques may display different patterns of behavior in social evaluation tasks.

Another limitation of the present design is that we used only one social evaluation method: a third-party method in which dogs evaluated how people acted towards a stranger. While we saw a significant effect of training on social evaluation ability in this context, it is possible that the training difference we observed may not generalize to another evaluative context. Future research should seek to compare various populations' ability to socially evaluate humans using other methods, such as a food sharing context (Kundey et al. 2011; Marshall-Pescini et al. 2011; Fredin et al. 2013; Nitzschner et al. 2014; Carballo et al. 2015), or through first-party direct experience (Nitzschner et al. 2012; Carballo et al. 2015). That said, note that we designed our method to control for factors other than prosocial behavior that might contribute to dogs' preferences. Our actors spoke in a neutral vocal timbre to account for the possibility that dogs would prefer a human who spoke in a friendly rather than harsh timbre. In addition, our primary experimenter reached for a nearby clipboard rather than a piece of food to control for the possibility that dogs would choose a location where they had witnessed an exchange of food instead rather than basing their choice on the actors' prosociality, per se. Finally, we used gender-matched actors to control for a gender bias.

Finally, our data cannot fully rule out the possibility that differences between breeds may explain the contrasting results across our two samples. Each of our samples had slightly different breeds of dogs, which raises the possibility that the training differences we observed were instead the result of breed differences. Although our sample size of individual breeds within conditions do not permit us to address this possibility statistically, mean breed performance across the trained and untrained groups do not seem to bear this out. For example, 86% (6/7) of our trained herding dogs showed a preference for the helper, whereas 0% of our untrained herding dogs (0/1) did so; similarly 100% of our trained sporting dogs preferred the helped (3/3) whereas only 60% of the untrained sporting dogs did so (3/5). Although our within-condition samples of different breed groups are not sufficiently large to permit a statistical analysis, our results still do not suggest that breed differences alone can explain the training effect we observed. To fully disentangle training differences from breed differences, future research should sample dogs with varying training histories of the same breed.

Using a helping paradigm in which dogs received third-party experience about unfamiliar humans, we show that agility dogs, but not pet dogs preferred to approach and accept a treat from a prosocial actor compared to an antisocial actor. Due to our use of an identical method in both samples, we conclude that differences in training between agility and pet dogs may account for the difference in social evaluation ability. Our finding that training may impact dogs' ability to socially evaluate humans suggests that while dogs may share some components of social evaluation with humans, dogs' social evaluation abilities may be less robust than those of our own species. Human social evaluation is present from infancy without the need for any specific input to enable the preference for prosocial individuals, and this preference occurs in many contexts. In contrast, dogs appear to socially evaluate humans only in specific contexts and after receiving extensive input via training.

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Data availability The data reported in this manuscript are included as supplementary material.

Compliance with ethical standards

Conflict of interest Not applicable.

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