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Dogs avoid people who behave negatively to their owner: third-party affective evaluation

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ABSTRACT

Social eavesdropping, or social evaluation of third-party interactions, is a first step to image scoring, which is a key feature of humans' large-scale cooperative society. Here we asked whether domestic dogs evaluate humans interacting with one another over neutral objects. In two experimental conditions, the dog's owner tried to open a container to get a junk object that was inside, then requested help from an actor sitting next to her/him, while the dog watched the interaction. In the Helper condition, the actor held the container stable to help the owner to open it. In the Nonhelper condition, the actor turned away and refused to help. In the Control condition, the actor simply turned away in the absence of any request for help. A neutral person sat at the other side of the owner throughout these interactions. After the interaction the actor and the neutral person each offered a piece of food to the dog. Dogs chose food randomly in the Helper and the Control conditions, but were biased against the actor in the Nonhelper condition. The dogs' avoidance of someone who behaved negatively to the owner suggests that social eavesdropping may be shared with a nonprimate species.

KEYWORDS

dogs, image scoring, social eavesdropping, third-party evaluation, social evaluation, social preference, cooperation, negativity bias, helping, moral judgment

Humans form large-scale cooperative societies, in which members often help one another for no apparent benefits to themselves. Indirect reciprocity has been proposed as an important factor maintaining this phenomenon (e.g. Melis & Semmann, 2010; Nowak & Sigmund, 2005). For this mechanism to work, members must be sensitive to third-party interactions. Such sensitivity is often referred to as social eavesdropping. It involves an affective evaluation of third-party interactions, and it appears to develop early in human infants. For instance, Hamlin, Wynn, and Bloom (2007) exposed infants as young as 6 months old to an animation, in which one simple-shaped character helped another to climb up a hill whereas another blocked the attempt. When the infants were asked to choose between the characters, they chose the nasty character less frequently than the helpful character. The same authors found this to be true even for 3-month-olds (Hamlin & Wynn, 2011; Hamlin, Wynn, & Bloom, 2010). Such evaluation later converts into differentiated helping behaviour; Vaish, Carpenter, and Tomasello (2010) demonstrated that 3-year-old children were less willing to give a ball to an actor who behaved harmfully to another than to a harmless person.

This sensitivity has been tested in a few nonhuman species including chimpanzees, *Pan troglodytes* (Subiaul, Vonk, Okamoto-Barth, & Barth, 2008), tufted capuchin monkeys, *Cebus apella* (Anderson, Kuroshima, Takimoto, & Fujita, 2013; Anderson, Takimoto,

48 Kuroshima, & Fujita, 2013), common marmosets, *Callithrix jacchus* (Kawai, Yasue,
49 Banno, & Ichinohe, 2014), domestic dogs, *Canis familiaris* (Freidin, Putrino, D'Orazio,
50 & Bentosela, 2013; Kundey, De Los Reyes, Royer, Molina, Monnier, German, & Coshun,
51 2011; Marshall-Pescini, Passalacqua, Ferrario, Valsecchi, Prato-Previde, 2011;
52 Nitzschner, Kaminski, Melis, & Tomasello 2014; Nitzschner, Melis, Kaminski, &
53 Tomasello, 2012), and *Labroides dimidiatus* cleaner fish (Bshary & Grutter, 2006). In
54 most of these studies the participants watched third-party interactions, usually exchanges,
55 involving food, which raises the possibility that participants simply preferred actors who
56 were more likely to give them a better chance of getting food. Two studies by Anderson
57 et al. (2013a, b) were more persuasive, as in those studies actors handled toys that were
58 of no apparent value to capuchin monkeys.
59 Whereas dogs are highly sensitive to human actions directed to themselves, whether
60 they are sensitive to third-party interactions among others has been under debate. Kundey
61 et al. (2011) showed that dogs preferred an actor who generously gave food to a begging
62 person over another who withheld it. But in that study the dogs also preferred an actor
63 who 'gave' food to a box rather than the beggar. Marshall-Pescini et al. (2011) reported
64 that dogs showed no preference when there was no beggar, thus demonstrating that some
65 interaction between the actor and the beggar was critical for the dogs' social preference.

By contrast, Nitzschner et al. (2012) argued that dogs evaluate only direct experiences; dogs preferred an actor who behaved nicely to them to an actor who ignored them, but showed no preference after watching actors behaving in these ways towards another dog. Evidence for such second-party evaluation was also obtained by Petter, Musolino, Roberts, and Cole (2009), who showed that dogs preferred a cooperative human to a deceiving human in an object choice task. Recently, Nitzschner et al. (2014) reported that dogs preferred the location, not the person, where a beggar received food. Thus, evidence for third-party social evaluations by dogs is weak.

Here we used a newly devised procedure to test whether dogs could evaluate actors who interacted with their owners either cooperatively or noncooperatively. To exclude the possibility of a preference due to association between one of the actors and attractive objects such as food, the actors never touched the object involved in the interaction; that is, the object stayed with the owner.

METHODS

Participants

Fifty-four domestic dogs and their owners participated. We excluded 26 more dogs that failed to complete the test trials due to weak motivation (N=16) or experimenter error

violating prescheduled test conditions and/or wrong acting (N=10). Dogs were considered to be insufficiently motivated if they failed to approach the actor or the neutral person within 30 s in three repeated trials. In this case no further tests were given. Only one dog in the Control group (see below) was excluded after watching the recorded video due to failure to attend to the acting. The dogs were randomly divided into three groups of 18 (nine males, nine females), and each participated in one of two experimental conditions called Helper and Nonhelper conditions, or a Control condition. The dogs were of various breeds, and ranged in age from 7 months to 14 years, with the average age for the Helper, Nonhelper and Control groups being 4.54, 5.02 and 5.67 years, respectively (see Appendix Table A1).

Ethical Note

The experiment was approved by the Animal Experiments Committee of the Graduate School of Letters, Kyoto University. The owners signed a written informed consent before their dogs were tested.

Apparatus and Procedure

Trials started with the owner in possession of a transparent cylindrical container (13 cm in diameter and 12.5 cm high), with a lid, in which there was an object (roll of vinyl tape, diameter 5.5 cm). The actor sat to one side of the owner, and a neutral person sat to

the other side. The dog was lightly restrained by an experimenter ca. 1 m from the owner (Fig. 1).

Upon a vocal cue from another experimenter, the owner started trying to open the lid of the container. For the two experimental groups, after 8–10 s of failed attempts, the owner requested help by turning towards and holding the container towards the actor. In the Helper condition, the actor responded by holding the bottom of the container. With this help, the owner successfully opened the lid, removed the object, showed it to the dog, then placed it back into the container and put the lid firmly back on. This final action ensured the same end state of the interaction as in the Nonhelper condition. In the Nonhelper condition, in response to the owner's request the actor showed unwillingness to help by turning away for 1–2 s. The owner continued trying to open the container, in vain. In the Control condition, after 8–10 s of attempting to open the lid the owner stopped and simply looked down at the container for 1–2 s while the actor turned away; critically, there was no request for help by the owner. The owner resumed trying, in vain.

All conditions ended with the owner placing the container in front of her/him. The entire demonstration lasted 15–20 s. Immediately thereafter, the actor and the neutral person extended both arms at the same time, offering a piece of the dog's favourite food on their palms. The dog was allowed to pick one reward.

120 To exclude any inadvertent cueing, neither the actor nor the neutral person looked at
121 the dog during the demonstration. During the choice phase, they looked down at the floor
122 and the owner's eyes were closed. The owner was ignorant of the purpose of the
123 experiment. These careful procedures were followed because some dogs can be trained
124 to use even momentary eye gaze to detect a cued container in an object choice task
125 (Miklósi, Polgárdi, Topál, & Csányi, 1998). The dog's choice was defined as the first
126 person the dog sniffed, licked or took the food from. This behaviour was obvious; post
127 hoc video analyses of 20% of the dogs' choices completely matched the on-site decision.
128 Each dog received four trials in which the identities of the actor and neutral person
129 were unchanged. The identity was different across participant dogs but both were females
130 unfamiliar to the dog. The left–right positions of actors were counterbalanced across trials
131 and on the first trial across individuals.
132
133 **RESULTS**
134 Figure 2 shows the number of times the actor was chosen in each condition. Whereas
135 this frequency was at chance in Control (Wilcoxon signed-rank test: $V = 9.50$, $P = 0.488$,
136 $r = 0.16$) and Helper conditions ($V = 48.00$, $P = 0.177$, $r = 0.32$), it was significantly
137 below chance in the Nonhelper condition with a satisfactory effect size ($V = 11.00$, $P =$

0.023, 95% confidence interval 0.50–1.00, r = 0.54). The difference in frequency of choosing the actor in the three conditions was significant, and the effect size (η^2) was satisfactory (Kruskal–Wallis test: χ^2_2 = 8.18, P = 0.017, η^2 = 0.15). Post hoc multiple comparisons using Mann–Whitney U tests with Bonferroni correction (corrected alpha = 0.017) revealed a significant difference between Nonhelper and Helper conditions with a satisfactory effect size (U = 244.50, N_1 = N_2 = 18, P = 0.006; 95% confidence interval 0.00–2.00, r = 0.46). There was no difference between Helper and Control conditions (U = 127.00, N_1 = N_2 = 18, P = 0.241, r = 0.20). Unfortunately, the difference between Nonhelper and Control conditions was not significant, either (U = 215.00, N_1 = N_2 = 18, P = 0.075, r = 0.30), because of one exceptional dog in the Nonhelper condition choosing the actor in all four trials (note that all other dogs in this condition chose the actor in two or fewer trials; see Appendix Table A2). However, a Fisher exact test of the number of dogs choosing the actor in different numbers of trials (see Appendix Table A2) revealed a significant difference between Nonhelper and Control conditions (P = 0.016).

There was also no significant correlation between dogs' age and choice of the actor (Spearman rank correlation: r_S = -0.35, P = 0.161, r_S = 0.40, P = 0.122 and r_S = -0.33, P = 0.185, respectively, for the Helper, Nonhelper and Control conditions.

DISCUSSION

The present results clearly show that after witnessing an actor behaving noncooperatively towards their owners, dogs avoided that actor, despite no explicit reason to do so in terms of likelihood of obtaining food. In contrast, dogs showed no clear preference for an actor who cooperated by helping their owners. This asymmetrical preference is reminiscent of that shown by 3- and 5-month-old infants in Hamlin et al.'s (2007; 2010) studies, 3-year-old children in Vaish et al.'s (2010) study and tufted capuchin monkeys in Anderson et al.'s (2013a, b) studies. It is noteworthy that in all of these studies, including the present one, interactions involved items that were of no direct interest to the participants. In fact no dog tried to get the item out of the container before or after choosing a person.

Might the turning away gesture in the Nonhelper condition somehow have caused the dogs to avoid the actor? The result for the Control condition makes this unlikely; dogs did not discriminate between the actor who spontaneously turned away and the neutral person. Therefore, explicit refusal to respond positively to the owner's request for help emerges as the most likely reason for the dogs' avoidance of that actor.

On may ask whether facial expression, not the interaction between the owner and the actor, could be the cue for the dogs' evaluation. However, this is also unlikely because the

dogs' differential choice was between two conditions in which the owner showed the same expressions resulting from the failure to open the container. In contrast, there was no difference in the dogs' choice between the Helper condition, the only condition in which the owner showed happiness, and the other (unhappy) conditions.

This ability for social eavesdropping might be expected to improve with age or amount of social experience with humans. However, we found no significant correlation between age and the dogs' choices. But whether dogs, like humans, engage in this type of social evaluation ability from an early age awaits additional work. Additionally, further work could address the issue of whether dogs, like young human infants (Johnson, Slaughter, & Carey, 1998), are more likely to respond in social ways to agents that are perceived as 'social' rather than 'nonsocial.'

It is important to note that in this study dogs chose between two persons, neither of whom was explicitly associated with the item (a roll of vinyl tape) targeted in the interaction; the nonhelpful actor simply ignored the apparatus and the helpful actor simply held the container. In previous studies claiming dogs' sensitivity to third-party interactions (Kundey et al., 2011; Marshall-Pescini et al., 2011), dogs might have approached the person or place that was associated with food. In fact Nitzschner et al., (2012, 2014) suggested that multiple cues might influence dogs' choices, such as where

192 donors stood and several features of the beggar's behaviour. Thus, the present results
193 provide much stronger evidence for social eavesdropping by dogs.

194 Importantly, we have found this ability in a highly social, noncooperatively breeding
195 species, which challenges a recent suggestion that sensitivity to unfair reciprocity in third-
196 party social exchanges may require cooperative and prosocial tendencies of species, as
197 shown in cooperative breeders such as marmosets (Kawai, et al., 2014). The present
198 demonstration suggests that highly developed social competence rather than cooperative
199 tendencies underlies these affective social evaluations.

200 Conceivably, this demonstration of social eavesdropping by dogs was facilitated by the
201 owner's involvement in the interaction. Attachments between dogs and their owners can
202 be strong, and the former may be particularly sensitive to how other people treat the latter.
203 Future work should include varying the identities of the people involved, as well as
204 assessing whether dogs also evaluate other dogs' third-party interactions. The last point
205 seems important for knowing the effects of domestication history; if dogs show a similar
206 sensitivity, then domestication enhanced their general social sensitivity, and if not, its
207 effects are object-specific.

208 The demonstration of social eavesdropping in a species distant from the human lineage
209 provides an interesting and important element for reconstructing the evolution of human

cooperative societies. An intriguing case in this context is the cleaner fish tested by Bshary and Grutter (2006). Bystanders of this species prefer staying near cooperative cleaners than cheaters that remove mucus rather than ectoparasites from the client. Although they apparently do this for their own benefit, this fish study underlines the advantage of testing social eavesdropping in various species of different taxa to better understand the evolutionary history of such social sensitivity.

Finally, a plausible account must address whether and how this social eavesdropping ability translates into reputation formation. A logical next step is to ask whether eavesdroppers take the presence of others into account to adjust their own behaviour. Initial work suggests that, unlike human children, chimpanzees do not attempt to 'manage' their reputations (Engelmann, Herrmann, & Tomasello, 2012), but a clearer picture must await further studies using alternative procedures, as well as assessing social eavesdropping abilities in other highly social animals, for example dolphins, elephants and corvids.

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232

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FIGURES

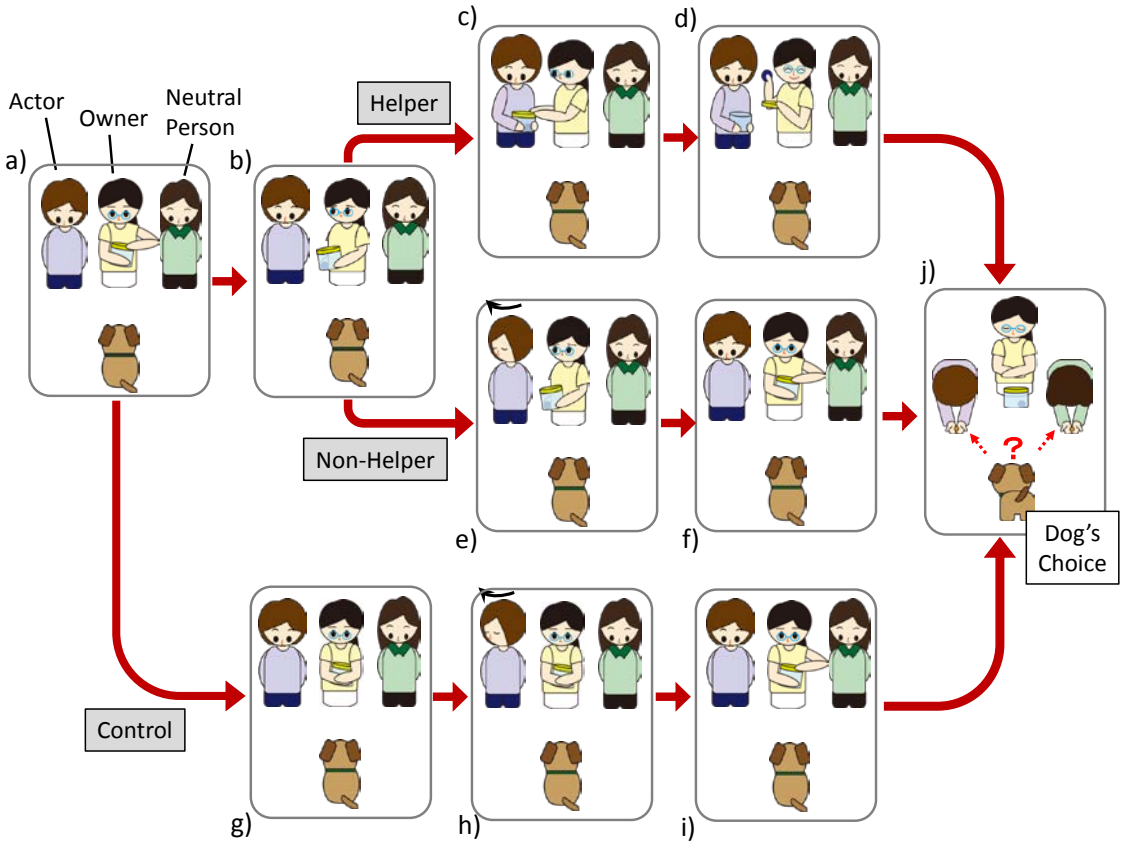

Figure 1. A schematic of the experimental procedure. (a) The owner tries to open a container to get a junk object that is inside. (b) In Helper and Nonhelper conditions, the owner requests help from the actor. (c) In the Helper condition (top row), the actor helps the owner, and (d) the owner successfully opens the container and shows the object to the dog. (e) In the Nonhelper condition (middle row), the actor turns away to show unwillingness to help, and (f) the owner continues trying to open the container, in vain. (g) In the Control condition (bottom row), the owner stops trying for a few seconds. (h) The actor turns away. (i) The owner resumes trying to open the container, in vain. (j) In all conditions, the dog finally chooses to take food from the actor or the neutral person.

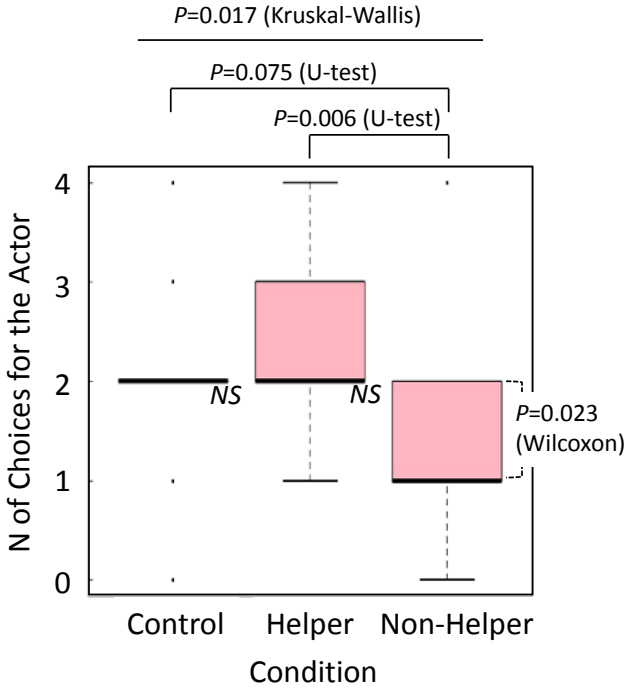

Figure 2. A box plot of the number of choices for the actor instead of the neutral person in each condition. The plot shows medians, first and third percentiles, ranges and outliers (dots).

Appendix

Table A1: Participant dogs and choice for the actor in each of the four trials

			Trial				
Breed	Sex	Age (year:month)	1	2	3	4	Total
Helper condition							
Bichon frise	F	2:09	1	1	0	1	3
Cavalier King Charles spaniel	F	8:08	1	1	1	1	4
Chihuahua	M	2:05	1	1	1	1	4
French bulldog	M	7:05	1	1	1	0	3
Golden retriever	M	2:09	1	0	1	0	2
Labrador retriever	F	2:04	0	1	0	1	2
Labrador retriever	F	3:11	0	0	1	0	1
Labrador retriever	M	0:08	0	0	1	1	2
Miniature schnauzer	F	0:07	1	1	0	1	3
Miniature schnauzer	M	10:02	0	1	0	0	1
Mongrel	F	9:08	0	0	1	0	1
Papillon	M	4:09	1	1	1	0	3
Rough collie	F	2:05	1	1	1	1	4
Shiba	F	6:00	0	0	1	0	1
Toy poodle	F	4:08	0	1	0	1	2
Toy poodle	M	4:05	1	0	1	0	2
Yorkshire terrier	M	3:10	0	1	0	1	2
Yorkshire terrier	M	4:03	0	1	0	1	2
Average/total/median		4.54	9	12	11	10	2
Nonhelper condition							
Australian labradoodle	F	2:07	1	0	0	1	2
Chihuahua	M	4:06	1	1	0	0	2
Labrador retriever	F	2:03	1	0	0	0	1
Labrador retriever	M	3:11	0	1	0	0	1
Miniature dachshund	M	14:05	1	0	1	0	2
Miniature schnauzer	F	1:09	0	0	0	0	0
Miniature schnauzer	M	2:02	0	0	0	1	1
Mongrel	F	6:06	0	1	0	1	2
Mongrel	M	7:10	0	0	1	0	1
Papillon	F	4:10	1	1	1	1	4
Pomeranian	M	2:03	0	0	0	1	1
Pug	F	2:07	0	0	1	0	1
Shiba	F	9:04	1	0	1	0	2

Toy poodle	M	2:00	1	0	0	0	1
Toy poodle	M	6:04	0	1	0	0	1
Toy poodle	M	10:03	0	0	0	0	0
Welsh corgi Pembroke	F	2:08	0	0	1	0	1
Yorkshire terrier	F	4:03	0	1	0	1	2
Average/total/median		5.02	7	6	6	6	1

Control condition

Australian labradoodle	F	2:05	1	1	0	1	3
Bernese mountain dog	F	3:07	0	1	1	0	2
Chihuahua	M	3:06	1	0	1	0	2
Chihuahua	M	3:09	1	0	0	1	2
Chihuahua	M	7:05	0	1	0	1	2
Chihuahua	F	10:06	1	1	0	1	3
Chihuahua	F	14:03	0	1	0	1	2
Golden retriever	F	4:06	0	0	1	1	2
Irish setter	M	1:04	0	1	0	1	2
Miniature schnauzer	M	3:02	0	1	0	1	2
Miniature schnauzer	M	7:02	0	0	0	0	0
Mongrel	F	2:02	1	1	1	1	4
Mongrel	F	4:02	0	1	0	1	2
Pomeranian	F	9:03	0	0	1	0	1
Pomeranian	F	9:06	1	0	1	0	2
Schipperke	M	5:03	1	0	1	0	2
Shiba	M	4:11	0	0	0	0	0
Toy Poodle	M	5:02	0	0	0	0	0
Average/total/median		5.67	7	9	7	10	2

M: male; F: female.

Table A2: The number of dogs choosing the actor rather than the neutral person in different numbers of trials (maximum: 4) in each condition

Condition/no. of choice	0	1	2	3	4	Median	Mode
Control condition	3	1	11	2	1	2	2
Helper condition	0	4	7	4	3	2	2
Nonhelper condition	2	9	6	0	1	1	1

Figure Captions

Figure 1. A schematic of the experimental procedure. (a) The owner tries to open a container to get a junk object that is inside. (b) In Helper and Nonhelper conditions, the owner requests help from the actor. (c) In the Helper condition (top row), the actor helps the owner, and (d) the owner successfully opens the container and shows the object to the dog. (e) In the Nonhelper condition (middle row), the actor turns away to show unwillingness to help, and (f) the owner continues trying to open the container, in vain. (g) In the Control condition (bottom row), the owner stops trying for a few seconds. (h) The actor turns away. (i) The owner resumes trying to open the container, in vain. (j) In all conditions, the dog finally chooses to take food from the actor or the neutral person.

Figure 2. A box plot of the number of choices for the actor instead of the neutral person in each condition. The plot shows medians, first and third percentiles, ranges and outliers in dots.