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Side matters: potential mechanisms underlying dogs' performance in a social eavesdropping paradigm

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Social eavesdropping is the gathering of information by observing interactions between other individuals. Previous studies have claimed that dogs, *Canis familiaris*, are able to use information obtained via social eavesdropping, that is, preferring a generous over a selfish human donor. However, in these studies the side was constant between the demonstrations and the dogs' choices, not controlling for potential location biases. In the crucial control condition of our experiments, the donors swapped places in half of the trials before the dogs chose. We found that first choice behaviour as well as the time dogs interacted with the generous donor were influenced by location (side). In a second experiment the subject's owner interacted with the two donors. Again, the result of the side control revealed that the critical factor was location (side) not person. The results of these experiments provide no evidence for social eavesdropping in dogs and show the importance of critical control conditions.

The ability to use information about unknown individuals on the basis of third-party interactions is widespread in the animal kingdom (birds: Amy & Leboucher, 2007; fish: Bshary & Grutter, 2006; Danchin, Giraldeau, Valone, & Wagner, 2004; Paz-y-Miño C, Bond, Kamil, & Balda, 2004; for a review of other species see Valone, 2007). In most species, such skills are confined to fighting or mating contexts and therefore are probably highly constrained (Subiaul, Vonk, Okamoto-Barth, & Barth, 2008).

In contrast, in humans the assessment of others based on indirect experience is a highly flexible ability that is considered to be a key component in human cooperation (Nowak & Sigmund, 1998, 2005; Wedekind & Milinski, 2000). There is also some evidence that our closest relatives, the chimpanzees, *Pan troglodytes*, use information gathered by witnessing interactions between others (Russell, Call, & Dunbar, 2008). More precisely, the chimpanzees in that study observed interactions of a beggar with a food-sharing experimenter versus a food-withholding experimenter and afterwards displayed a preference for the food-sharing experimenter. However, in another study, chimpanzees did not show a spontaneous preference for a 'generous' donor (Subiaul et al., 2008). Given the inconsistent results it remains unclear whether chimpanzees are flexibly able to gather information about humans' food-sharing behaviour via third-party interactions.

Several studies provide some evidence that dogs' cognitive skills in some domains seem to be more flexible than those of species more closely related to humans (Bräuer, Kaminski, Riedel, Call, & Tomasello, 2006; Hare, Brown, Williamson, & Tomasello, 2002). Dogs are social-living animals and have lived among humans for at least 15 000 years (Savolainen, Zhang, Luo, Lundeberg, & Leitner, 2002; Vilà et al., 1997). The findings of the latest study even suggest an onset of domestication in Europe up to 32 100 years ago (Thalmann et al., 2013). During this time they have developed a number of outstanding sociocognitive skills, which have enabled them to interact and communicate with humans (Miklósi, Topál, & Csányi, 2004).

Since dogs rely on humans to provide them with food (Clutton-Brock, 1995; Coppinger & Coppinger, 2002), it should also be an advantage for a dog to be able to assess humans' food-sharing tendencies via observation. Indeed, two recent studies have shown that dogs seem to use information about humans' food-sharing tendencies after having observed several interactions between a food-giving (generous) donor and food-withholding (selfish) donor and an unknown human beggar. Kundey et al. (2010) found that dogs chose the demonstrator who gave food to a human recipient more often than the withholding demonstrator. However, the subjects in this study also favoured the human who 'gave' food to a wooden box over a 'selfish' human, raising the

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possibility that rather than assessing the experimenters' food-sharing behaviour based on an interaction they had witnessed, the dogs simply associated food with one but not with the other donor. In a similar study, Marshall-Pescini, Passalacqua, Ferrario, Valsecchi, and Prato-Previde (2011) also showed that dogs preferred the food-giving over the food-withholding experimenter. Additionally, they conducted a ghost control, in which no beggar was present but the demonstrators performed the same actions as in the experimental condition. In this control condition, dogs did not prefer one over the other experimenter. This finding shows that the dogs did not prefer the food-sharing experimenter because of her specific behaviour but took the actual interactions between the beggar and the donor into account. However, in this ghost control no food transfer took place, which could be the crucial difference between the two different beggar–donor interactions in the experimental versus the ghost control condition. Therefore, it is possible that dogs simply preferred the side where they saw a food transfer during the beggar–donor interactions in the experimental condition (since the positions of the experimenters were not altered between the observation and test choosing phase). With this method it is not possible to rule out location bias as a potential factor influencing the dogs' performance. In contrast to the two studies highlighted, which yielded positive findings on dogs' social-eavesdropping abilities, another recent study found no evidence for a flexible use of information gathered via observation of third-party interactions in dogs (Nitzschner, Melis, Kaminski, & Tomasello, 2012). In that study, subjects preferred a nice experimenter, who played with them, over an ignoring experimenter, who ignored them completely, after they had had direct experiences with them both, but not if they only witnessed interactions between the two experimenters and another dog well known to them. However, in that study no food was involved and no local cues were provided, minimizing the possibility of forming associations based on simpler mechanisms such as local enhancement. That simple associations based on seeing food being exchanged can lead to preferences for some location over the other had been shown in a recent study with capuchin monkeys, *Cebus apella* (Brosnan & de Waal, 2009). Here subjects were trained to return tokens to one of two human experimenters. One of the experimenters reliably rewarded the subject with food after s/he had received the token; the other one was an unreliable exchanger (i.e. failed to give a reward after receiving the token). In one condition, the reliable and unreliable exchanger switched positions after the subject had received the token. Analyses showed that the capuchins returned the token to the location where they had received it previously, but not to the reliable exchanger. They also failed to choose the reliable experimenter after watching interactions between another capuchin monkey and the two experimenters. The findings suggest that simpler mechanisms, such as a bias for spatial location, could be involved in this kind of experiment and potentially underlie some of the positive results reported so far (Brosnan & de Waal, 2009). Indeed, location biases have also been found in dogs in different experimental set-ups, most often showing a preference for the location where they last saw a reward (Doré, Fiset, Goulet, Dumas, & Gagnon, 1996; Fiset & LeBlanc, 2007; Fiset & Plourde, 2013; Miller, Gipson, Vaughan, Rayburn-Reeves, & Zentall, 2009; Rooijakkers, Kaminski, & Call, 2009).

In the current experiments, we tried to find out whether the dogs' performance in a social-eavesdropping paradigm is potentially influenced by a location bias. For this reason, we performed two experiments following the methodology of Marshall-Pescini, Passalacqua, et al. (2011). In the first experiment, an unknown stranger played the part of the beggar whereas this role was filled by the owner in the second experiment. Critically, we added a side control condition to both experiments. In this side control condition the two donors (generous versus selfish) swapped positions in half of the trials after the demonstrations but before the subjects were free to choose. With this additional condition we can control for the influence of local cues provided during the demonstrations (e.g. food transfer on only one side).

EXPERIMENT 1

In this experiment we assessed whether dogs use information about two unknown experimenters (the donors) after having witnessed interactions between those two donors and a third person (the beggar). They observed the unknown beggar begging from the two donors, with the 'generous' donor giving food to the beggar and the 'selfish' donor withholding the food. The prediction was that if dogs are able to use the indirect information about the food-sharing behaviour of the two donors, they should preferentially approach the 'generous' donor first and/or interact with her for longer even if the two donors swap positions before the dogs choose.

Methods

Subjects

Forty-eight dogs, 24 males and 24 females, living as pets with their owners participated in this experiment. Ten additional dogs had to be excluded for several reasons (four subjects never chose any of the experimenters, four subjects were uncomfortable in the test situation, one subject snatched a piece of food from one experimenter during the first test trial and one subject was not videotaped because of technical problems). For more detailed information about subjects in experiment 1, see Appendix Table A1. Only dogs older than 1 year (mean age $\pm$ SD $= 5.8 \pm 3.1$ years) and unfamiliar with both experimenters were selected from a database of owners who had volunteered to participate in this type of behavioural study. No breeds were excluded. The experiment was conducted in a room dedicated to dog studies. The owners of the dogs were present throughout the procedure.

Procedure

Set-up and experimental design. The experiment took place in a small empty room (2.90 $\times$ 3.80 m). The two female experimenters were seated 2.5 m across from each other. The subject was placed perpendicular to and equidistant from the experimenters (1.5 m, see Fig. 1) and was held by its owner. A curtain was placed in front of the subject (distance 50 cm). The whole procedure was videotaped by a wide-angle video camera, which was positioned on a tripod located next to the door (Fig. 1).

Before the test started, the experimenter (M.N.) explained the procedure to the owner, while the dog was allowed to move around the room freely. Following Marshall-Pescini, Passalacqua, et al. (2011), each trial consisted of two parts: observation phase and test phase. Each dog participated in four complete trials (observation + test), with the positions of the experimenters counterbalanced within and across subjects. Half of the dogs experienced M.N. being generous and half of the dogs experienced M.N. being selfish (mirrored by the second experimenter K.E.). Each observation phase lasted approximately 50 s, and each test phase lasted 20 s. The subjects were randomly assigned to the experimental or the side control condition (see Appendix Table A1).

Observation phase. In the experimental condition, we followed the procedure of the experimental group in Marshall-Pescini, Passalacqua, et al. (2011). The owner was asked to sit down on the allocated location and to hold his/her dog between his/her legs, not to interact with the dog and to remain seated. The two female