Animal Behaviour 82 (2011) 651–658

Contents lists available at ScienceDirect

Animal Behaviour

journal homepage: www.elsevier.com/locate/anbehav

Dogs, *Canis familiaris*, communicate with humans to request but not to inform

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ARTICLE INFO

Article history:
Received 24 February 2010
Initial acceptance 28 April 2010
Final acceptance 10 June 2011
Available online 29 July 2011
MS. number: 10-00128R

Keywords:
Canis familiaris
communication
dog
helping
showing behaviour
social cognition

Dogs are especially skilful at comprehending human communicative signals. This raises the question of whether they are also able to produce such signals flexibly, specifically, whether they helpfully produce indicative ('showing') behaviours to inform an ignorant human. In experiment 1, dogs indicated the location of an object more frequently when it was something they wanted themselves than when it was something the human wanted. There was some suggestion that this might be different when the human was their owner. So in experiment 2 we investigated whether dogs could understand when the owner needed helpful information to find a particular object (out of two) that they needed. They did not. Our findings, therefore, do not support the hypothesis that dogs communicate with humans to inform them of things they do not know.

Dogs are especially skilful at comprehending human communicative gestures. If confronted with a situation in which they are not informed about the location of a piece of food, dogs can successfully find the food if a human points, gazes or even glances towards the correct location (reviewed in Miklosi & Soproni 2006). Several pieces of evidence suggest that these skills are indeed special. Apes, humans' closest living relatives, do not seem to use human-given gestures in a cooperative communicative context as readily as dogs if both species are directly compared (Hare et al. 2002; Bräuer et al. 2006; K. Kirchhofer, F. Zimmermann, J. Kaminski & M. Tomasello, unpublished data). Furthermore, a number of studies have shown that dogs' abilities do not simply reflect a general canid skill. Wolves, *Canis lupus*, dogs' closest living relatives, do not use human-given pointing gestures to the same extent as dogs, even if raised under identical conditions (Hare et al. 2002; Miklosi et al. 2003; Virányi et al. 2008) unless they experienced a certain learning period or are specially trained, for example with a clicker (Udell et al. 2008; Gacsi et al. 2009; for a recent debate about this issue see Udell et al. 2008; Hare et al. 2010). Finally, there is evidence suggesting that extensive learning during ontogeny alone cannot account for dogs' abilities in this domain. Puppies follow human pointing from an early age (6 weeks), even when that gesture requires them to move away from the human's hand (Hare et al. 2002; Riedel et al. 2008). Taken together, this evidence suggests that dogs' readiness to receive and act on human communication may have its roots in their relatively long evolutionary history alongside humans (Miklosi et al. 2003; Hare & Tomasello 2005; Udell et al. 2010).

Dogs' skill in comprehending human cooperative signals raises the question of whether they are also able to produce such cooperative signals flexibly. There is evidence that dogs produce context-specific barks (Yin 2002; Yin & McCowan 2004), which humans can classify even if they are naïve to interactions with dogs (Pongrácz et al. 2005, 2006). There is also evidence that dogs produce indicative behaviours (e.g. jumping, running back and forth, gaze alternation, etc.) persistently to indicate the location of food to a human who has not seen the food being placed there (Hare et al. 1998; Miklósi et al. 2000; Gaunet 2010). Miklósi et al. (2000) defined and summarized these behaviours under the term 'showing behaviour'. They tested dogs in three different conditions to see whether they would inform the owner of the location of a reward if they themselves could not reach it. The dog was treated in one of the following three ways: it remained with the owner after another individual had hidden the reward in one of three bowls; it was left alone after the food was hidden; or it remained with the owner after a helper had entered and petted the dog but did not hide an object. When both reward and owner were present, the dogs looked more frequently at their owner and the location of the reward, and alternated their gaze between the two more frequently than in the other conditions. The fact that they behaved

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0003-3472/$38.00
doi:10.1016/j.anbehav.2011.06.015

differently when they were alone with the reward as opposed to with their owner suggests that this type of 'showing' behaviour was indeed communicative (Miklósi et al. 2000). However, even though clearly produced communicatively, it is as yet unclear whether the dogs' behaviour in this setting was produced with the intent to inform the human about something. This would imply that dogs understood the informative value of their behaviour as well as took into account when information was necessary (e.g. interpret the human's state of knowledge) and relevant. Alternatively, the dogs' behaviour in these settings may be a form of begging behaviour or simply a direct request produced because the dogs were unable to obtain the reward for themselves (Gómez 2005). The difference is that here dogs would simply produce the behaviour without taking into account the human's need for information and/or their behaviour may not be underlain by any helpful motive.

Humans communicate with the intent to inform others. One cognitive prerequisite for this form of communication is the ability to determine when information is needed. Children from early on seem to be able to determine when others are knowledgeable or ignorant about certain aspects of the environment (e.g. Onishi & Baillargeon 2005; Moll & Tomasello 2006), and they take this into account when communicating with them. For example, they only inform others about certain entities when this information was not shared before and is therefore new to the other (Liszkowski et al. 2006, 2008). A second prerequisite is a cooperative communicative motivation to provide others with information when they need it (Tomasello 2008). Thus, while apes, for example, seem to understand quite a bit about others' knowledge states (reviewed in Call & Tomasello 2008), humans seem uniquely motivated from an early age to share interest and information with others (Tomasello et al. 2005; Tomasello 2008). From a very early age they thus provide others with the information they need, even if doing so has no direct benefit for themselves (Liszkowski et al. 2008; Bullinger et al. 2011).

One important question is thus whether dogs' 'showing behaviour' has this human-like cooperative structure of informing (i.e. recognizing an ignorant recipient and being motivated to help by providing the needed information). If dogs' comprehension of human-given gestures is based on a general understanding of the cooperative nature of the situation, we might expect the same general motivation to underlie dogs' production of communicative signals, or at least we can ask whether they do. This would then support the idea that the communicative signals produced by dogs are more flexible and cooperative than was formerly thought. The aim of the current study, therefore, was to investigate how flexible dogs are in their production of indicative behaviours ('showing behaviour'). In experiment 1, we examined not only whether dogs would request a hidden object in which they were interested but also whether they would inform a human about an object she desired. In experiment 2, we investigated whether dogs are able to understand when the human needs helpful information to find a desired object.

EXPERIMENT 1

The aim of this experiment was to investigate whether dogs indicate the location of a hidden object not just to request a desired object but also to inform others about it. We therefore confronted the dogs with a situation in which an object was placed out of reach behind an occluder and the experimenter was not informed about the object's location. The dog's interest in the object as well as the human's varied. We measured whether the dog's communication towards this location depended on their or the human's interest in the object.

Methods

Subjects

Forty dogs (20 females and 20 males) of various breeds and ages (range 1–13 years old, mean age = 5.45 years) participated in this experiment. All dogs lived with their owners as pets. All but eight dogs had participated in other studies. The owners were recruited through personal contacts and took part in the experiment voluntarily. The precondition for every dog was that they were interested in toys. This was tested in a short prephase during which the experimenter played with the dog. If dogs could not be motivated to play with a toy (e.g. ignored the toy when the experimenter was throwing it) they were dropped from the experiment. Six of the dogs tested were specially trained rescue dogs from the 'Rettungshunde' centre. Dogs were divided into two groups: 24 (14 males and 10 females) were tested without their owners, while the other 16 (six males and 10 females) were tested with their owners to see whether this would change the dogs' behaviour. To avoid potential training by the owners, the precise research question was not explained to them until after the experiment was finished. Dogs were tested individually between April 2005 and June 2006.

Procedure

All tests were performed in a test room (8.67 × 3.98 m) at the Max Planck Institute for Evolutionary Anthropology (see Fig. 1) by two experimenters (E1 and E2). Four cupboards (80 × 26 cm), serving as hiding places for the objects, were attached to the walls at a height of 1.80 m. The distance of each cupboard to E1 was the same (4.50 m). On each cupboard stood an occluder (25 × 18 cm), which ensured that neither the dog nor E1 could see the object during the trial. The room had two doors: E1 always left and entered the room through door 1 and E2 always entered and left the room through door 2.

One experimenter (E1) handled and later requested the object and another (E2) hid the object. The role of E1 was performed by the owner for dogs tested with their owners; for those dogs tested without an owner present this role was performed by a stranger (M.N.).

At the beginning of each trial, E1 (stranger or owner) held the object while entering the room through door 1 with the dog. She sat down on the marked area and either handled or ignored the object for 1 min, depending on the condition. We manipulated whether the dog and/or E1 were interested in the object resulting in the following four conditions.

(1) Dog only: E1 put the object on the marked spot in front of her and read a paper or a magazine while ignoring the dog. The dog was

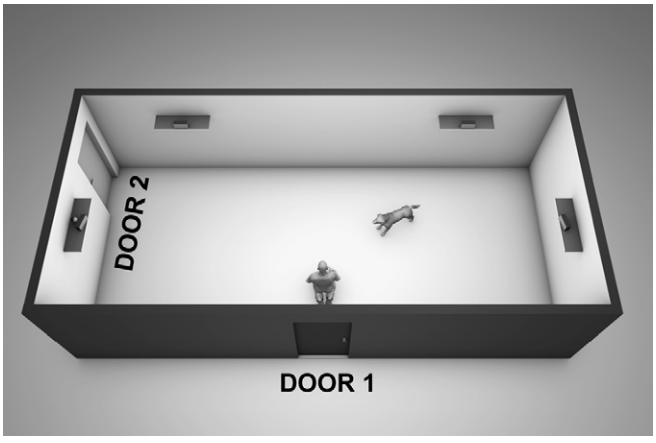

Figure 1. General setting for experiments 1 and 2.