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When do dogs help humans?

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ABSTRACT

Here we investigate whether domestic dogs (*Canis familiaris*) engage in instrumental helping towards humans without special training. We hypothesized that dogs would help a human if the human's goal was made as obvious as possible. Therefore we used a set-up in which a human attempted to enter a compartment within a room (the "target room") in order to get a key. The dog could open the door to the target room by pushing a button. We varied the way in which the experimenter expressed how she wanted to enter the target room (reaching, pushing the door, communicating with the dog) and the relationship between human and dog (owner versus stranger). Dogs helped in two situations: (1) when the human pointed at the button and (2) when the humans communicated naturally to the dogs, i.e. without a predetermined series of actions. In these situations, dogs continued to open the door without receiving any reward. We therefore conclude that dogs are motivated to help and that an experimenter's natural behaviours facilitated the dogs' recognition of the human's goal. Interestingly the identity of the experimenter had no influence on the behaviour of the dogs.

1. Introduction

In recent years there has been an unprecedented interest in the area of prosocial behaviour in nonhuman animals. A behaviour which aims to benefit another individual or group of individuals and occurs voluntary has been subsumed under the general term prosocial behaviour (Wispe, 1972). There are four types of prosocial behaviour (Warneken and Tomasello, 2009a): comforting (Zahnwaxler et al., 1992), sharing (Hay et al., 1991), informing (Liszkowski et al., 2006) and instrumental helping. Especially instrumental helping, defined as acting for another individual to achieve its behavioural goal (Warneken and Tomasello, 2006, 2009a, 2009b), has received considerable attention.

Helping involves a cost to the actor and a benefit to the recipient and it has a cognitive and a motivational component. The actor who helps to solve a recipient's problem (1) must recognize the other's goal and (2) has to be motivated to help (Warneken and Tomasello, 2009b).

Recent studies suggest that human children have a biological predisposition to help others, even non-relatives, with their instrumental goals. Human infants start instrumentally helping others at the age of 14 months (Warneken and Tomasello, 2007). In studies by Warneken et al. (2006, 2007) it was shown that 18-month-old children help in various situations. In one example, when a human experimenter accidently dropped an object on the floor, the child gave it back to him, and in another, the child opened a cabinet door for him when he was not able to do it himself. In the control conditions in which the experimenter did not need help, the children did not perform these actions (Warneken and Tomasello, 2006, 2007). Children also reliably point to inform a human about a hidden tool. They point regardless of whether they benefit, and they remain motivated over time (Bullinger et al., 2011; Liszkowski et al., 2006).

Warneken et al. (2007) found that the provision of material rewards is neither necessary to elicit helping behaviour nor to increase its rate. In fact, children who had received

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material rewards helped less in subsequent trials than children who had not received any reward. The fact that material rewards decreased even 20-month-olds' motivation to help led the authors to conclude that there is an intrinsic motivation in humans to help others (Warneken et al., 2007; Warneken and Tomasello, 2008).

Chimpanzees also help others in a variety of situations such as in agonistic and feeding contexts. However, researchers have noted remarkable differences in the helping behaviour of the two species. Like human children, chimpanzees reliably help humans in out-of-reach tasks (Warneken and Tomasello, 2006). They seem to recognize the other's goal, i.e. they hand the object to the human when she needs it and reaches for it. They are also motivated to help without receiving any benefit such as reward or praise (Warneken et al., 2007). However, chimpanzees have failed to help without being requested to do so in all previous studies. Perhaps in these types of tasks the chimpanzees have problems inferring the human's goals or they do not know how to intervene (Warneken and Tomasello, 2006). In other situations when chimpanzees are clearly able to recognize the human's goal they do *not* help. Several studies have shown that chimpanzees and other apes inform humans about the location of hidden tools but only if it is beneficial for them – i.e., when the human uses the tool to retrieve a reward for the ape. If the object is irrelevant to the chimpanzee or orang-utan, the rate of indicating decreases over time until it is nearly extinguished (Bullinger et al., 2011; Zimmermann et al., 2009). Bonobos produce more 'gifts' but they do not seem to distinguish whether the human needs them or not (Zimmermann et al., 2009).

Chimpanzees also help conspecifics in situations similar to those mentioned above. For instance, they can open a door for an unrelated group mate and they help a group mate to obtain a tool (Melis et al., 2008; Warneken et al., 2007) or release a latch that allows another chimpanzee to access a tool or food (Melis et al., 2011). In contrast, other studies have shown no other-regarding preferences in chimpanzees: when they had a choice, at no cost to themselves, between pulling a tray with food for themselves *and* a partner or a tray with food only for themselves they did not preferentially deliver food to their partners (Jensen et al., 2006; Silk et al., 2005). However, Melis et al. (2011) found that chimpanzees helped conspecifics to obtain food and non-food items during a situation in which the donor could not get the food herself. Interestingly, donors helped only when recipients tried to get the food or tried to get the attention of the donor. Thus, as noted previously, a key factor determining helping behaviour is whether the recipient provides cues signalling the need for help. Melis et al. (2011) argued that the cues provided by the recipient may signal to the other to 'do something', and that the donors have the motivation to help when the goal of the recipient is clear. Another possibility is that donors simply help recipients to terminate the recipient's requests (Melis et al., 2011).

In the current study, we investigated whether dogs engage in instrumental helping towards humans. The relationship between dogs and humans has existed for at least 15,000 years (Savolainen et al., 2002). During the process of domestication, dogs have evolved special social skills to read the social and communicative behaviour of humans (Cooper et al., 2003; Hare and Tomasello, 2005; Miklosi et al., 2004). They are sensitive to humans' attention and perspective (Call et al., 2003; Gacsi et al., 2004; Kaminski et al., 2011; Viranyi et al., 2004). Dogs are also very skilful in locating hidden food by using certain human-given social cues. When food is hidden under one of two cups (the so called object choice design), dogs can use cues such as pointing, gazing, bowing or a marker placed on the baited cup to find the hidden food (Agnetta et al., 2000; Hare et al., 1998; Hare and Tomasello, 1999; McKinley and Sambrook, 2000; Miklosi et al., 1998; Soproni et al., 2001, 2002). Not only are dogs able to use human's communicative cues, but they are also able to communicate the place of the hidden food to their owner (Miklosi et al., 2000).

Although the initial reason why humans domesticated dogs 15,000 years ago remains unknown, dogs were later bred and kept for various purposes including protection, hunting and herding. Since the last century, dogs have also been used for rescue, search, service and guide purposes (Serpell, 1995; Svartberg and Forkman, 2002). Despite extensive evidence of dogs helping humans, it remains unknown whether dogs are intrinsically motivated (as humans are) to help their human companions achieve their goals. In other words, it is unclear if dogs that help humans actually understand human intentions and if they are motivated to help for the sake of helping, rather than simply trained to follow certain commands or react to particular situations in certain ways.

Kaminski et al. (2011) investigated whether dogs would help a human to find a hidden object. The object was hidden in one out of four locations while the dog watched. They found that dogs showed naïve humans the location of the hidden objects. As in previous studies (Miklosi et al., 2000) the dogs had no problem indicating the location of objects in which they were interested (i.e. toys). However, they sometimes indicated the location of objects in which they were not interested (i.e. a hole-puncher, a vase). Interestingly, they showed the human the place of these objects more frequently when it was their owner (in half of the cases) than when it was a stranger (in approximately 20% of the cases). Moreover, the rate of indicating those objects did not decrease over time, suggesting that the dogs maintained their motivation to inform humans about objects in which they were not interested, even in the absence of any benefit. However, although dogs often performed this informative showing behaviour, they usually indicated the *wrong* place of the object when the human was interested in it, showing the right location in only about 15% of the cases. Thus, dogs seemed to be motivated to help or at least willing to please the human, perhaps prompted by the human's utterances and search behaviour.

The aim of the current study was to investigate whether dogs would help a human if the human's goal was made as obvious as possible. We used a set-up in which a human tried to enter a target room in order to get a key. The dog could open the door to the target room by pushing a button. If the dogs were able to understand the human's goal and were motivated to help, they should open the door when the human tries to enter the target room. In

different help conditions we varied how the human expressed that she wanted to enter the target room (reaching, pushing the door, communicating with the dog) and the relationship between human and dog (owner versus stranger). We compared the help conditions with control conditions in which the human did not try to enter the room. Thus, our question was, under what circumstances dogs would help a human to open a door. We conducted three experiments and in each experiment different dogs were used.

2. Experiment 1: Ostensive cues

Here we investigated whether ostensive and other behavioural cues help dogs to realize the human's goal to open the door to the target room. Ostensive cues are communicative cues, e.g. a high pitched voice and eye contact. They are produced in order to indicate when information is relevant and help an audience to understand the communicator's intention (Csibra and Gergely, 2009; Sperber and Wilson, 1986, 1995). Dogs are sensitive to various ostensive cues (Topal et al., 2009; Viranyi et al., 2004). These cues can provoke increased arousal and greater levels of active behaviour (Range et al., 2009) as well as elicit indicative behaviour (Kaminski et al., 2011). In the current experiment the human showed her intention to the dog in various ways. In one help condition (h-SUPPORT (fixed)) the human simply looked at and reached into the target room and pushed against the door without using ostensive cues to communicate with the dog. In the other help conditions (h-GAZE, h-TALK, COMMAND) she used various ostensive and other communicative cues to communicate directly with the dog in order to make her goal as obvious as possible.

2.1. Methods

2.1.1. Subjects

Twelve dogs (*Canis familiaris*; 6 females and 6 males) of various breeds and ages (range = 1–9 years old, mean age = 4.8 years) participated in this experiment (see Table 1). All subjects lived as pet dogs with their owners in Leipzig and received normal obedience training typical for domestic dogs. The dog owners took part in the study voluntarily. During the test the owners were absent. Furthermore, owners were not informed about the design of the experiment or the specifics of their dog's task in the study until after the last session was completed.

The preconditions to participate in this experiment were that the dog had to be (1) food-motivated, (2) at least one year old and (3) able to learn to open the target door. Dogs were trained the first day to open the target door. From the 13 invited dogs all except one passed the training and participated in the test. Every dog was tested individually by the same experimenter E (KS). The study adhered to the Guidelines for the use of Animals in Research.

2.1.2. Materials

2.1.2.1. Training. The training was conducted in a training room (5.90 m × 3.60 m). Plexiglas walls were positioned to create a compartment in the room (2.45 m × 2.00 m). The target door (height 112 cm/width 80 cm) was installed on one side of the wall. The door was Plexiglas and was locked magnetically. A wooden button (30 cm × 30 cm) resting on the floor was located outside the compartment. This button had to be pushed by the dog in order to open the target door. Depending on the progress of the training, the button was placed in several positions in the room.

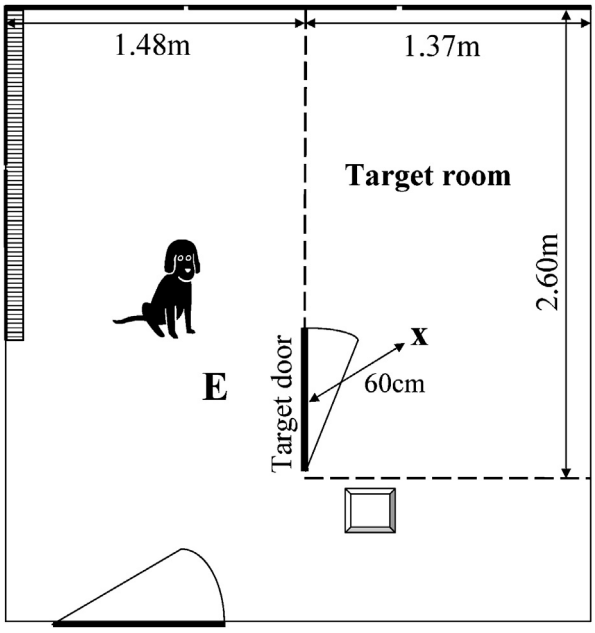

Fig. 1. Overview of the testing room for the help conditions (*x* – location of key; *E* – position of the E; □ – button).

2.1.2.2. Test. Fig. 1 shows the testing room (3.60 m × 2.90 m). As with the training room, there was a compartment surrounded by Plexiglas walls. This was the target room, which could be accessed by a door in the same way as it could be accessed during training. Also the button used was identical to the one used in training, and it was placed directly in front of the target door. E either stood in front of the target door (helping conditions) or sat upon a low windowsill opposite the target door and read a book. The dogs could move freely about the room throughout the duration of the test. In the target room there was a bunch of keys (from now on called key) or one piece of food for the dog, depending on the conditions.

2.1.3. Procedure

2.1.3.1. Training and warm-up. During training, dogs learned in three steps that when they pressed the button, the target door would open. In the first step, each dog learned to push the button. The dog was rewarded with pieces of food and praise when s/he put his/her paw on the button (for example by walking over it). In the second step, the button was associated with the target door. E stood in the compartment and the target door was closed. The button was located next to the target door. E pointed at the button, calling the dog's name and in this way encouraged the dog to press the button. Again the dog was rewarded with praise and food. In the final step, the dogs had to be

Table 1
Name, breed, gender and age of the subjects in each experiment.

Subject	Breed	Gender	Age (years)	Experiment
Alma	Mongrel (Irish Setter)[b]	Female[a]	5	1
Baghira	Mongrel (Shepherd dog)[b]	Female[a]	5	1
Balou	Schapendoes[b]	Male[a]	8	1
Bazi	Mongrel[b]	Male	1	1
Emmi	Weimaraner[b]	Female	5	1
Fara	Mongrel (Shepherd dog × Border Collie)	Female[a]	8	1
FeFo	Parson Russell Terrier	Male[a]	1	1
Filou	Mongrel (Australian Shepherd)[b]	Male[a]	9	1
Gonzo	Labrador[b]	Male	5	1
Linus	Golden Retriever[b]	Male[a]	6	1
Motte	Mongrel	Female[a]	1	1
Zosi	Mongrel	Female[a]	4	1
Amy	Magyar Vizsla	Female	7	2
Blue	French bulldog	Male	2	2
Caja	Mongrel (Doberman)[b]	Female	7	2
Chester	Beagle	Male	4	2
Felix	Mongrel[b]	Male[a]	5	2
Gordo	Mongrel (Dogo Canario × Doberman)	Male	3	2
Judy	French bulldog	Female	2	2
Lara	Golden Retriever	Female	1	2
Lea	Mongrel (Leonberger)[b]	Female	9	2
Migo	Jack Russel Terrier[b]	Male	1	2
Nilsson	Mongrel[b]	Male[a]	2	2
Susi	Mongrel (American StaffordshireTerrier)	Female	2	2
Aaron	Eurasier[b]	Male	3	3
Aimee	Collie[b]	Female	2	3
Atze	Wire-haired dachshund	Male[a]	5	3
Benji	Mongrel[b]	Male[a]	5	3
Jasper	Gun dog	Male	1	3
Karou	Berger des Pyrenees[b]	Male	3	3
Kira	Mongrel (Pit bull)[b]	Female[a]	5	3
LucaH	Podenco[b]	Female[a]	1	3
LucaS	Labrador	Female	3	3
Maxl	Shepherd dog[b]	Male	2	3
Maya	Mongrel (Tibetan Spaniel)	Female[a]	2	3
Via	Doberman	Female	1	3

[a] Castrated.
[b] Participated in a dog course such as puppy school, obedience, agility, rescue or companion dog training.

able to open the target door without any help (or request) within 1 min. More specifically, E showed a piece of food to the dog and placed it on the ground in the compartment. Then E stepped back and looked at the ground while the dog pressed the button to open the door and fetched the food. This final step was repeated three times on the second day to make sure that the dog remembered the task.

The dog was trained until s/he was able to complete the final step of the task. This took on average 75 min including a number of breaks to keep the dog motivated. If a dog did not learn the task within 2 h, s/he was excluded from the study. Note that dogs did not learn any particular command to press the button. Instead, E used different words to encourage the dog, such as "Come here!", "Give paw!" and "Go on it!".

Warm-up trials were conducted on days 2–5 prior to every test to ensure that dogs were able to transfer the learned association between pressing the button and opening the door from the training room to the testing room. The warm-ups were similar to the final step of the training (see above), except that they were conducted in the testing room. Thus, E was in the target room, placed a piece of food on the ground, and the dog had to open the door by pressing the button and eat the food within 1 min of the E placing the food. There were two warm-up trials on the second day, conducted after the final step of the training. A third warm-up trial was performed only if the dog required verbal encouragement from the experimenter during the first two trials. Within three trials all dogs managed to solve the task without additional encouragement. On days 3–5 there was only one warm-up trial prior to the test trials.

As in other studies (see for example Bullinger et al., 2011) training was needed to teach the dogs the potential helping behaviour, i.e. to press the button in order to open the target door. We tried to keep the training as short and as different from the test conditions as possible (for example in contrast to the test E was inside the target room and she avoided to use specific commands).

2.1.3.2. Test. Each test trial began when E and the dog entered the testing room together. The target door was closed and inside the target room there was either a key (helping conditions) or a piece of food (food condition). E then preformed various patterns of behaviour depending on the condition (see below). If the dog pushed the button to open the target door, E either showed no reaction (food condition) or entered the target room, picked up the key, went back and sat on the windowsill and read the booklet (helping conditions). The dog was not praised for opening

the door in either condition. After 1 min the trial ended, and E left the room with the dog.

Dogs were presented with five conditions. In four help conditions (marked by an "h") E needed help to open the target door because the key was in the target room. The design of the h-SUPPORT (fixed) condition was the basis for the procedure of the other three help conditions. In each of these three help conditions, E added various ostensive cues to make her goal as obvious as possible. In the fifth condition (FOOD) we tested whether the dog was motivated and still able to open the door. These were the five conditions:

h-SUPPORT (fixed): The key was inside the target room. E stood in front of the target door. She tried to enter the target room in order to get the key. Therefore she performed three actions: (1) *looking* – staring into the target room through the target door, (2) *movements* towards the target door – pushing and shaking the target door and (3) *reaching* for the key above the target door). These three actions were carried out in a predetermined order: 10 s looking/10 s movements/10 s looking/10 s reaching/10 s looking/10 s movements.

h-GAZE: The procedure was the same as in condition h-SUPPORT (fixed) with the addition of E alternating her gaze once between the dog and the key in the target room during the phases *looking* and *reaching*.

h-TALK: The procedure was the same as in condition h-GAZE with the addition of E talking to the dog with a high pitched voice while she looked to the key inside the target room. She used the following sentences: "Oh, where is my key?/There is my key!/How can I get it?/I want my key!/How did it get there?/Usually this door is not closed." The order of these sentences was always the same. Dogs were never addressed by their name.

COMMAND: The procedure was the same as in condition h-GAZE with the addition of E saying "Open!" in a commanding tone, while she alternated her gaze, moving towards the target door and reaching for the key. Note that this command was not used during training. We used it here to test whether dogs would open the door because they heard any command.

FOOD: One piece of food was inside the target room. E took the booklet and sat on the low windowsill opposite from the target door. She then read the booklet during the remainder of the trial.

Each dog received four trials per condition. These 20 trials were presented in four sessions. Each session included five trials, one of each condition, that were presented in randomized order. Dogs received one session per day. Thus, after the training on the first day, they received the four sessions from day two to day five. To keep the dogs motivated and focused, there was a break of at least 10 min between trials.

2.1.4. Scoring and data analysis

All data was coded from the video material by the same person (KS). Our main dependent variable was whether the dog pushed the button to open the target door within the 60 s of the trial. Additionally, we coded whether the dog entered the target room after s/he had opened the target door, i.e. whether she moved inside the target room with the whole body.

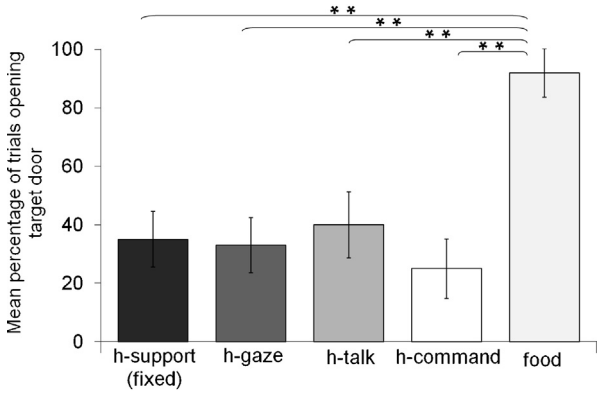

Fig. 2. Experiment 1: Mean percentage of trials in which the dogs opened the target door (mean ± SE) in the five different conditions (*$P \leq 0.05$; **$P \leq 0.01$).

We coded whether the dogs sat or lay down before s/he opened the target door (or before the trial was over in case s/he did not open the door). Sit/lie was defined as any posture in which the dog's hindquarters touched the ground, including scratching behaviour. This variable allowed us to check whether dogs' body posture differed between conditions.

Finally we coded what E did just before the dog opened the door in all conditions (except the food condition). This was defined as the behaviour of E within the 2 s before the dog pressed the button. This measure included movements towards the target door, reaching for the key above the target door, gaze-alternation between dog and key, or no detectable behaviour.

Whether the dogs opened the target door and entered the target room was unambiguous. An independent observer who was not familiar with the purpose of the study coded 25% of all trials randomly selected. The level of agreement was excellent for "open target door" (*Kappa* = 1.00, $N = 60$), "enter target room" (*Kappa* = 1.00, $N = 39$) and "sit/lie down" (*Kappa* = 1.00, $N = 60$) and good for "E's behaviours before dogs pressed the button" (*Spearman correlation* $r_s = 0.82$, $N = 15$).

All statistical tests were two-tailed and the alpha level was set to 0.05. We used nonparametric statistics: Friedman test and Wilcoxon signed rank tests for comparison of the conditions.

2.2. Results

Fig. 2 shows the mean percentage of trials in which dogs opened the target door in the five conditions. There were significant differences between the conditions (Friedman test: $\chi^2 = 22.989$, $N = 12$, $P < 0.001$). The dogs opened the target door significantly more often in the FOOD condition compared to all help conditions (Wilcoxon: FOOD vs. h-SUPPORT (fixed): $T = 55.00$, $N = 10$, $P = 0.002$; FOOD vs. h-GAZE: $T = 55.00$, $N = 10$, $P = 0.002$; FOOD vs. h-TALK: $T = 52.00$, $N = 10$, $P = 0.010$; FOOD vs. COMMAND: $T = 55.00$, $N = 10$, $P = 0.002$). All dogs except one opened the target door in the FOOD condition in every session. There were, however, no significant differences between the

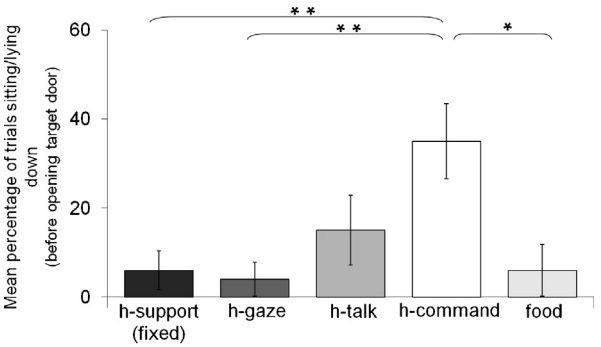

Fig. 3. Experiment 1: Mean percentage of trials (mean ± SE) the dogs sat/lay down before they opened the target door (*$P \leq 0.05$; **$P \leq 0.01$).

help conditions. Moreover, the number of trials in which dogs opened the target door did not change over sessions, indicating that there was no learning or decrease in motivation to open the door (Sessions 1 and 2 vs. Sessions 3 and 4, Wilcoxon tests, non-significant for all five conditions: h-SUPPORT (fixed): $T = 20.00$, $N = 8$, $P = 1.000$; h-GAZE: $T = 10.00$, $N = 5$, $P = 0.750$; h-TALK: $T = 9.00$, $N = 5$, $P = 1.000$; COMMAND: $T = 6.50$, $N = 4$, $P = 0.750$; FOOD: $T = 0$, $N = 0$, $P = 1.000$).

Dogs entered the target room in 86% of the trials after they had opened the door, but there were no significant differences across conditions (Friedman test: $\chi^2 = 8.571$, $N = 4$, $P = 0.053$). Fig. 3 shows that there were significant differences between the conditions in the mean percentage of trials in which dogs sat/lay down (Friedman test: $\chi^2 = 19.927$, $N = 12$, $P < 0.001$). The dogs sat/lay down in significantly more trials when E gave a command than in the other conditions (Wilcoxon: COMMAND vs. FOOD: $T = 42.50$, $N = 9$, $P = 0.020$; COMMAND vs. h-SUPPORT (fixed): $T = 36.00$, $N = 8$, $P = 0.008$; COMMAND vs. h-GAZE: $T = 36.00$, $N = 8$, $P = 0.008$) except for the h-TALK condition (Wilcoxon: COMMAND vs. h-TALK: $T = 25.50$, $N = 7$, $P = 0.078$). None of the other comparisons were significantly different.

In trials in which dogs opened the door they did so after E had reached for the key in more than 20% of the trials in the helping conditions. In the COMMAND condition dogs pressed the button mainly after movements towards the door (25%) and gaze alternation (35%, see supplementary material).

2.3. Discussion

Dogs opened the target door when there was food in the room but they rarely did so for the human regardless of how she communicated her intention. The question this raises is why dogs did not help the human. Next we discuss several possibilities.

We can rule out that their lack of helping behaviour was due to their inability to open the door because they opened it nearly in every trial when they could obtain food for themselves. This is similar to the findings of Kaminski et al. (2011) in which dogs reliably indicated the place of an object in which they themselves were interested.

One possibility is that dogs just opened the door for the food because they had learned that in the training session. They did not do so in the other conditions because the situation differed from the training session. However, the training session also differed from the FOOD condition and, more importantly, dogs did open the door in the other conditions in about 30% of the trials.

If we consider that dogs did more than simply repeating what they had learned there are two possibilities. Either dogs failed to grasp what the experimenter wanted or they simply were not motivated to help. Although the latter explanation could account for the results of two of the helping conditions, it cannot explain their failure in the command condition. In that condition, dogs received a command to perform an action, which is a familiar situation for dogs and one to which they have learned to respond by complying. In the current experiment, dogs were requested to push the button and to open the target door, but dogs did not do so. Interestingly, we found that dogs sat/lay down more often in the COMMAND condition compared to the other conditions (except condition h-TALK). Scheider et al. (2011) also found that when pointing gestures were paired with an imperative command-like tone of voice without a meaningful context (e.g., there was nothing to retrieve or inspect), dogs sat or lay down in the direction of the pointing gesture. Scheider et al. (2011) interpreted this as evidence that the imperative tone of voice triggered obedient and even submissive behaviour, as can be seen in the findings of the current study. It is also possible that dogs sat/lay down simply because they were confused or frustrated because they did not know how to react.

Thus, dogs may have been willing in principle to comply but they had not previously learned how, to comply to the command "open!" and could not infer from the human's behaviour what they were supposed to do. It is conceivable that dogs failed to open the door not because they were unmotivated to comply (at least in the command condition) but because they failed to grasp the human's goal. In the next two experiments we investigated these motivation and goal attribution hypotheses further. In experiment 2 we presented another set of ostensive cues designed to make the human's goals more transparent, in order to see whether dogs would help more when they received this further assistance. In experiment 3 we attempted to boost the motivation to help by enrolling the owners in the test, hoping that dogs would be more willing to help their owners than strangers.

3. Experiment 2: The pointing gesture

In this experiment the dogs received additional information to make the goal of the human more obvious. Therefore we used a pointing gesture (pointing towards the button) in order to show the dogs what they had to do. Studies have shown that dogs spontaneously respond to variations of human pointing gestures in multiple types of situations (Hare and Tomasello, 1999; Miklosi et al., 2005; Scheider et al., 2011; Soproni et al., 2001). In addition to the pointing condition, we introduced a baseline condition, in which the human was not interested in the content of the target room. This was to rule out that the dogs opened the

target door just because they had learned to open it when the human was present – irrespective of the human's need for help.

3.1. Methods

3.1.1. Subjects

Twelve dogs (*Canis familiaris;* 6 females and 6 males) of various breeds and ages (range = 1–9 years old, mean age = 3.75 years) participated in this second experiment (see Table 1). These dogs had not participated in experiment 1. The preconditions to participate in the experiment were the same as in experiment 1. From 13 invited dogs all except one passed the training and participated in the test.

3.1.2. Materials and procedure

Materials were the same as in experiment 1. The same was true for the training, warm-up and the test procedure, – except that the conditions were different. The experimental design was the same as in experiment 1: each dog received four trials per condition, presented in four sessions.

The four conditions differed from each other in the contents of the target room and in E's interest in the content. There were two helping conditions marked by the letter "h":

h-SUPPORT (fixed): This was similar to the condition h-SUPPORT (fixed) in experiment 1. The key was inside the target room and E tried to enter the target room using the three actions: *looking, movements* and *reaching.* The only difference to experiment 1 was the order and the latency of the actions (20 s looking/10 s movements/20 s looking/10 s reaching).

h-POINT: The procedure was the same as in condition h-SUPPORT (fixed). In addition, E pointed to the button twice during the action *looking.* The pointing gesture was accompanied by gaze alternation. While E looked at the dog, her arm was in front of her body, but when she looked at the button her arm and the forefinger was outstretched and pointed towards the button.

NO INTEREST: The key was inside the target room. E took the booklet and sat on the low windowsill opposite from the target door. She then read the booklet during the remainder of the trial. If the dog opened the target door, the E did not react at all and continued reading.

FOOD: The procedure was exactly the same as in FOOD condition in experiment 1. Food was inside the target room and E sat at the low windowsill and read the booklet during the remainder of the trial.

3.1.3. Scoring and data analysis

We coded again the variables "open target door", "enter target room" and "E's behaviours before dogs pressed the button" using the same basic definition as in experiment 1. "E's behaviours before dogs pressed the button" this time also included pointing. We did not code the variable 'dog sat/lay down' because dogs sat/lay down only in very few trials. Again an independent observer coded 25% of the original video material for reliability purposes. The levels of agreement for "open target door" (*Kappa* = 1.00, $N = 48$, $P < 0.001$), "enter target room" (*Kappa* = 1.00, $N = 33$, $P < 0.001$) and "E's behaviours before dogs pressed the button" (*Spearman Correlation* $r_s = 0.90$, $N = 24$) were perfect. We used the same statistical tests as in experiment 1.

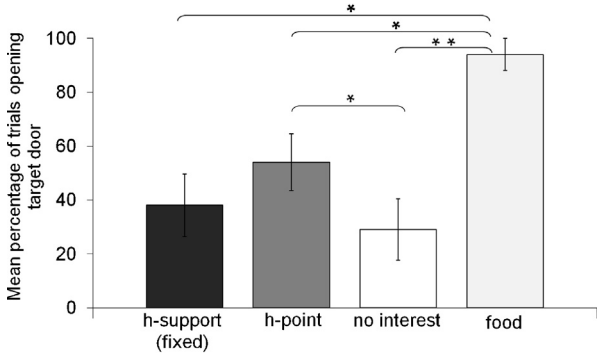

Fig. 4. Experiment 2: Mean percentage of trials in which the dogs opened the target door (mean ± SE) in the four different conditions ($^{*}P \leq 0.05$; $^{**}P \leq 0.01$).

3.2. Results

Fig. 4 shows the mean percentage of trials in which dogs opened the target door in the four conditions. There were significant differences between the conditions (Friedman test: $\chi^2 = 17.633$, $N = 12$, $P < 0.001$). The dogs opened the target door significantly more often in the FOOD condition compared to all other conditions (Wilcoxon: FOOD vs. h-SUPPORT (fixed): $T = 51.00$, $N = 10$, $P = 0.014$; FOOD vs. h-POINT: $T = 48.50$, $N = 10$, $P = 0.027$; FOOD vs. NO INTEREST: $T = 45.00$, $N = 9$, $P = 0.004$). Moreover, the dogs opened the target door significantly more often in the h-POINT condition compared to the NO INTEREST condition (Wilcoxon: $T = 41.50$, $N = 9$, $P = 0.027$). However, there was no significant difference between the baseline NO INTEREST condition and the other help-condition, h-SUPPORT (fixed). As in experiment 1 there was no increase or decrease in the number of trials in which dogs opened the door over sessions (Sessions 1 and 2 vs. Sessions 3 and 4, Wilcoxon tests, non-significant for all four conditions: h-SUPPORT (fixed): $T = 7.50$, $N = 4$, $P = 0.625$; h-POINT: $T = 18.00$, $N = 8$, $P = 1.000$; NO INTEREST: $T = 5.00$, $N = 4$, $P = 1.000$; FOOD: $T = 1.00$, $N = 1$, $P = 1.000$). After dogs had opened the target door, dogs entered the target room in 81% of all trials, but there was no difference between conditions (Friedman test: $\chi^2 = 6.614$, $N = 5$, $P = 0.086$).

In the h-SUPPORT condition dogs opened the door mainly after E had reached for the key and moved towards the door. In contrast in the h-POINT condition dogs pressed the button after E had pointed to the button in 46% of the cases (see supplementary material).

3.3. Discussion

Dogs helped the human to open the door if the human displayed her goal very clearly by using a pointing gesture directed towards the button. In that condition, dogs opened the door more often than when the human was uninterested in the content of the target room (but less than for themselves). Moreover, when dogs pressed the

button they often did it immediately after E had pointed to the button. Therefore, the failure to help in experiment 1 could be attributed, at least partly, to the type of cue given by the experimenter. One key question, however, is how dogs understand the pointing gesture, as informative or imperative.

Szetei et al. (2003) tested dogs in an object-choice task, in which the human experimenter pointed towards the incorrect location, the one without food. Even when dogs had witnessed the baiting process and therefore knew where the food was hidden, they followed the pointing cue and went to the empty cup. Szetei et al. (2003) concluded that the dogs understood the pointing gesture as an imperative cue (i.e., a command) rather than an informative cue (see also Petter et al., 2009). However, Scheider et al. (2013) found different results with a similar set-up. In their study, when dogs had witnessed the baiting process, they chose the baited cup, even when the human pointed to the empty cup. Scheider et al. (2013) concluded that dogs are able to understand the human pointing as an informative gesture. One possible reason for this difference between the two studies is that Scheider et al. (2013) presented the pointing gesture accompanied by gaze alternation. Scheider et al. (2013) argued that it is conceivable that dogs might have needed gaze alternation to construe pointing as an information cue about the location of the hidden food.

In the current study, the dogs had learned during the training how to open the target door. To make the dogs approach the button during training, E also sometimes pointed to the button. This could have influenced the dogs' behaviour in the test (although, note that other cues used in the training – such as high pitched voice – did not lead to increased opening of the door in the test). Dogs may then have interpreted the human-given pointing cue as an imperative gesture ("Go there!"). But it is also possible that dogs perceived the pointing gesture as information ("Help me by pushing the button.") rather than as a command. Two facts seem to support this assumption. First, the pointing gesture was accompanied by gaze alternation, as it had been Scheider's et al. (2013) study, which might have been crucial for the dogs' recognition of the gesture as informative. Second, there was no decrease of performance in the pointing condition. If dogs perceived the gesture as imperative, they should have opened the target door less often over trials, as they did not receive any reward for their action. Indeed, Elgier et al. (2009) found that dogs stopped following the pointing cue in an object choice task when their choice was unrewarded because the human pointed to the wrong container.

The results of experiment 1 and 2 suggest that the motivation to help the human exists in dogs, but they need a strong cue such as a pointing gesture to understand what to do. However, it is also possible that dogs' helping behaviour depends on the individual person they are going to help. In the study by Kaminski et al. (2011), dogs indicated the location of a non-desired object more frequently to the owner than to a stranger. Thus, it is conceivable that dogs are more likely to open the door for the owner than for a stranger. Dogs may prefer to help the owner for two reasons: first, because they are more motivated to help her as they have a close relationship, and second because it is easier for dogs to understand the owners' goal because they have had more experience interpreting and responding to her particular behaviours. To investigate whether the identity of the human would influence the helping behaviour of the dogs, we conducted a third experiment.

4. Experiment 3: Owner versus stranger

In this experiment, we investigated two aspects that could influence dogs' helping behaviour. First, we wanted to know whether the identity of the human would change the dogs' performance. Therefore we tested the same dogs with the owner and with the stranger, hypothesizing that dogs would prefer to help the owner as was found in Kaminski et al's (2011) study. Second, we wanted to know whether the natural behaviour of the experimenter – in contrast to the predetermined order of actions in experiment 1 and 2 – would improve the performance of the dogs. Therefore the human was allowed to perform the actions to express her goal however she wanted, including calling the dog by his/her name.

4.1. Methods

4.1.1. Subjects

Twelve dogs (*Canis familiaris;* 6 females and 6 males) of various breeds and ages (range = 1–5 years old, mean age = 2.75 years) participated in the third experiment (see Table 1). Only dogs naïve to the test and not involved in one of the other two experiments were tested. The preconditions to participate were the same as in the previous experiments. 18 dogs were invited but six dogs did not pass the training and were excluded from the study. In contrast to the previous experiments owners were present during some conditions (see below).

4.1.2. Materials and procedure

Materials were similar to the previous experiments. The same was true for the training procedure, warm-up, and the test. The only difference was that dogs were trained by a third person, so that dogs had not experienced the apparatus associated with the person that later tested them, neither with the stranger, nor with the owner. Dogs received three different conditions:

h-SUPPORT (natural): The key was inside the target room and the human (E or the owner) tried to enter the target room. In contrast to the h-SUPPORT (fixed) conditions of the previous experiments there was no predetermined order of actions. The human was allowed to do anything to make her goal as obvious as possible such as reach for and point to the key, push the target door, bend down to the dog etc. She could talk to the dogs but only using the following sentences: "Open the door! Have a look! I want my key! Where is my key? How do I get there?" and the name of the dog. However, the human was *not* allowed to use different phrases (such as a fetch command) and to point to the button.

NO INTEREST: The procedure was the same as in the NO INTEREST condition of experiment 2: The key was inside the target room and the human read the booklet during the trial.

FOOD: The procedure was the same as in the FOOD condition of experiment 1 and 2.

For the h-SUPPORT (natural) condition the owners were told to show their dog that they wanted to get into the target room in order to get the key. They were instructed to follow certain rules while they showed their intention (for example not pointing to the button, see above). The third person, who also trained the dogs, could watch the owner during each trial on a monitor. In the three cases in which owners did not follow the instructions (i.e. praising the dog for opening the door, not retrieving the key after the dog opened the door, using a command that was not allowed), the trial was repeated.

Again each dog was tested in four trials per condition. These 12 trials were presented in four sessions. These sessions included three trials, one of each condition, that were presented in randomized order. In two sessions, the owner was the experimenter, and in two sessions the stranger (KS) was the experimenter. During each day of testing, dogs were presented with two sessions, one with the owner, and one with the stranger. Six dogs started with the owner-session and the other six dogs with the stranger-session. Thus, after the training on the first day, dogs received two sessions on the second day and two sessions on the third day.

4.1.3. Scoring and data analysis

We coded again the variables "open target door", "enter target room" and "E's behaviours before dogs pressed the button" using the same definition as in the previous experiment. Again an independent observer coded 25% of the original video material randomly selected for reliability purposes. The levels of agreement for "open target door" (*Kappa* = 1.00, $N = 36$, $P < 0.001$), "enter target room" (*Kappa* = 1.00, $N = 32$, $P < 0.001$) and "E's behaviours before dogs pressed the button" (*Spearman Correlation* $r_s = 0.93$, $N = 12$) were perfect. We used the same statistical tests as in experiment 1 and 2.

4.2. Results

Fig. 5 shows the mean percentage of trials in which dogs opened the target door in the three conditions for the two experimenters. There were no significant differences between the owner and the stranger as experimenter (Wilcoxon: h-SUPPORT (natural): Owner vs. Stranger: $T = 6.00$, $N = 3$, $P = 0.250$; NO INTEREST: Owner vs. Stranger: $T = 22.50$, $N = 9$, $P = 1.000$; FOOD: Owner vs. Stranger: $T = 1.50$, $N = 2$, $P = 1.000$). For that reason the data for owner and stranger were then combined. There were significant differences between the conditions in the number of trials in which dogs opened the target door (Friedman test: $\chi^2 = 12.054$, $N = 12$, $P = 0.002$).

Dogs opened the target door significantly more often in condition FOOD and h-SUPPORT (natural) compared to the NO INTEREST condition (Wilcoxon signed rank test: FOOD vs. NO INTEREST: $T = 36.00$, $N = 8$, $P = 0.008$; h-SUPPORT (natural) vs. NO INTEREST: $T = 62.50$, $N = 11$, $P = 0.007$). There were, however, no significant differences between the help condition, h-SUPPORT (natural) and the FOOD condition. (Wilcoxon: $T = 13.00$, $N = 6$, $P = 0.625$). As in the previous experiments there was no increase or decrease in the number of trials in which dogs opened the door over sessions (Sessions 1 and 2 vs. Sessions 3 and 4, Wilcoxon tests, non-significant for all three conditions: h-SUPPORT (natural): $T = 3.00$, $N = 2$, $P = 0.500$; NO INTEREST: $T = 27.00$, $N = 8$, $P = 0.289$; FOOD: $T = 4.50$, $N = 3$, $P = 0.750$).

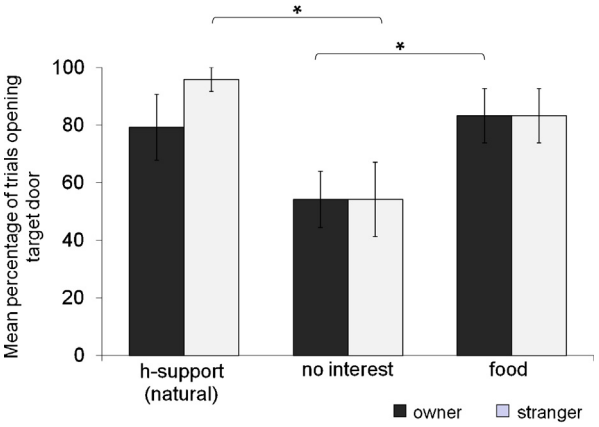

Fig. 5. Experiment 3: Owner versus stranger. Mean percentage of trials (mean ± SE) in which the dogs opened the target door in the three conditions for the two experimenters (*$P \leq 0.05$; **$P \leq 0.01$).

When dogs had opened the target door, they entered in 86% of the trials. There were significant differences across conditions (Friedman test: $\chi^2 = 7.724$, $N = 11$, $P = 0.016$). Dogs entered the target room significantly more often in the FOOD condition compared to the h-SUPPORT (natural) condition (Wilcoxon: $T = 33.50$, $N = 8$, $P = 0.039$).

When dogs opened the door in the h-SUPPORT condition they pressed the button mainly after the human had reached for the key (43%) or pointed at the key (32%, see supplementary material).

4.3. Discussion

The results of experiment 3 support the hypothesis that dogs will help humans when their goal is made more apparent. Dogs opened the target door for the human when the human tried to get into the target room. Interestingly, dogs opened the door for the human as often as for themselves. This suggests that dogs were highly motivated to help the human because they did so without receiving any reward or praise for their behaviour in the help condition.

Dogs differentiated between the situation in which the human needed help and the situation in which she was not interested in opening the target door. This is similar to findings with children and chimpanzees who performed the target behaviour more often in conditions in which the human really needed help (Warneken et al., 2007; Warneken and Tomasello, 2006, 2007). In contrast to the children and chimpanzees, dogs did not distinguish between the object the owner needed for a certain activity and a non-target object that was irrelevant for the owner (Kaminski et al., 2011). This result contrasts with what we found in the current study. Perhaps this difference between studies is due to the different set-up. When the human tries to open a door and reaches for an object, this may

be more obvious for the dogs than when she is searching for an object that she has used before.

There is an alternative explanation for why dogs in the current experiment opened the door preferentially when the human required help. Instead of gauging the goal of the human, dogs may have been much more aroused when the human communicated her goal than when she was not interested and read the booklet. Because dogs were aroused by the behaviour of the human, they did what they had learned in the training–they pressed the button. This would be similar to the low-level interpretation of chimpanzees' helping behaviour in the study of Melis et al. (2011), that they do not recognize the intentions of the conspecific but 'do something' until the signalling stops. However, we think that this explanation is unlikely because dogs did not press the button in all the other helping conditions in the earlier experiments in which the human was also very active. Moreover, in experiment 3, dogs helped to open the door even though they had no previous experience with the experimenter (owner/stranger) and the apparatus, having been trained by a third person. Thus, it seems to be more likely that dogs perceived the human's goal instead of just being aroused.

In this alternative explanation based on arousal, one would expect that dogs are more aroused when the owner – instead of a stranger – shows activity. But interestingly, dogs did not differentiate between the owner and the stranger being the experimenter. In contrast to other studies (Kaminski et al., 2011) dogs did not help the owner more than a stranger. This is surprising because dogs have a close relationship with their owner (Gacsi et al., 2001). It is possible that their motivation to help is not dependent upon the identity of the recipient, as the same is true for human children (Warneken and Tomasello, 2006, 2007) and apes (Warneken et al., 2007).

5. General discussion

Dogs, in the current study, helped a human to open a door to a target room if the human explicitly communicated her goal to the dog. The results suggest that dogs are willing to help if they recognize the human's goal. They opened the door for the human as often as for themselves and they continued to do so over trials even without being rewarded.

One could argue that dogs opened the door during the experiments because they had learned it in the training and were intermittently rewarded in the food condition. In other words, training might have formed the expectation that pushing the target button will result in a food reward also during the test. But there are four reasons that make this possibility unlikely. First, in each of the three experiments dogs received the food condition–and were therefore intermittently rewarded–but they did not open the door often in the help conditions of experiment 1 and 2. Second, we found no change in the door-opening frequency within experiments. Third, although in experiment 3 there was no difference between the help condition and the food condition, dogs entered the target room less in the help condition than in the food condition indicating that they did not expect a reward. Fourth, one could argue that dogs opened the door more often in the help condition of experiment 3, because the interval between a rewarded food condition and the other conditions was shorter because there were fewer conditions than in the other experiments. However, the pattern of frequent opening in the help condition of experiment 3 but not in the other experiments appeared already in the first session in which all dogs were once rewarded in the food condition (see supplementary material). Overall, this indicates that dogs indeed helped without getting a reward and not because they were trained to do so.

The study raises the question of what aspects of the human's behaviour make her goal perceivable for the dog. Actions towards the closed target door were not sufficient to elicit helping. Ostensive cues, such as gaze alternation between the dog and target room and talking to the dog in a high pitched voice, also did not lead to helping. Dogs only helped in two situations: (1), when the human pointed at the button – then they might have perceived the pointing gesture as information about what to do and (2), when the humans communicated naturally to the dogs, i.e. without a predetermined sequence of actions. Note that in the latter case the human basically showed the same actions as in the other helping conditions such as looking into the target room, pushing the target door, pointing to and reaching for the target object, and talking to the dog. The only different behaviour the human showed was to bend over towards the dog and to call the dog by name. However, when we examined what behaviours of the human triggered the dogs to push the button, then the pattern was quite similar in all three experiments. Dogs opened the door mainly after the human reached for the target, moved towards the door, and pointed at the button or at the target.

Thus, it is quite likely that dogs helped more in the third experiment because the human was allowed to react to the behaviour of the dog and adjust her actions accordingly. If it is really the case that this natural behaviour helped the dogs to recognize the human's goal, this has to be considered when conducting further studies about the social cognitive skills of dogs. Predetermined sequences of behaviours are used to ensure that the conditions remain comparable, but if the human is behaving too inflexibly, this might prevent dogs from exhibiting the full potential of their cognitive skills. Alternatively, it may be that the dog is simply not attributing any goals but is instead being instrumentally guided towards the human's goal.

Nonetheless, the results of the current study show that dogs only help if the human is communicating with them in a certain way. Some authors have raised the question of whether such helping, if it is to be considered pro-socially motivated, should occur in the absence of signals for help (Burkart et al., 2007; Melis et al., 2011). This may be a criterion that excludes most nonhuman animals since it appears that communicative signals are the main source by which individuals perceive that the recipient needs help. Our closest living relatives are also more likely to help a human when she communicates her goal through signals. Chimpanzees helped more when the human called the subject by name, reached for the object, or alternated her gaze between the chimpanzee and the object, than when she showed neutral behaviour (Warneken et al., 2007; Warneken and Tomasello, 2006). The same was found in

helping situations between chimpanzees. If the conspecific made the goal obvious and requested help by clapping hands or banging against the cage, chimpanzees helped more often (Melis et al., 2011; Yamamoto et al., 2009).

Human children, chimpanzees and also dogs help when the goal of the recipient is obvious. The difference in the helping behaviour of the species might lie in how the goal is recognized and in subjects' level of motivation. Human children understand the intention of the recipient even if s/he is only focusing on the object s/he needs; i.e. reaching for a marker that dropped on the floor (Warneken et al., 2007; Warneken and Tomasello, 2006, 2007). Chimpanzees help frequently when the recipient not only focuses on the object but also calls the attention of the chimpanzee (Melis et al., 2011; Warneken et al., 2007; Yamamoto et al., 2009). For dogs the human goal is only obvious when the humans communicate naturally to the dogs, using ostensive cues and pointing. Regarding the motivation to help, dogs behave more like children than like chimpanzees. They seem to be highly motivated, because they continue to help over trials even without being rewarded (see also Kaminski et al., 2011). Chimpanzees seem to be less motivated to help, as in some tasks they do not help at all (Warneken and Tomasello, 2006) and in other tasks – such as showing where a tool is hidden, some species stop indicating when the tool is no longer relevant for them (Bullinger et al., 2011; Zimmermann et al., 2009).

In conclusion, dogs were highly motivated to help a human, when the human's goal was apparent by means of a communicative signal. Dogs' difficulty in such situations seems to be in perceiving the human's goal and knowing how to intervene, rather than in their willingness to help. The most effective way for a human to obtain help is to communicate with the dog in a natural way. However, this raises the possibility that dogs were instrumentally guided to the goal rather than they determined by themselves what the human wanted. Additionally, the crucial role that human signals played in dogs' responses may lead some authors to prefer terms like compliance or obedience rather than helping. However, we argue that restricting the notion of helping only to those cases without a communicative exchange is too restrictive. Therefore, we prefer to use helping in a broader sense but making a clear distinction between help preceded by a communicative request from help not preceded by it. Further studies should investigate whether dogs would help in other tasks and what aspect of communication makes the human goal obvious. Finally it would be important to investigate whether dogs with special training (such as service dogs) are especially skilful in perceiving the human's goal or whether they are simply more easily guided to the goal.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.applanim.2013.07.009.

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