The effect of the human communicative cues and the demonstrator's presence on the choice behaviour of dogs (*Canis familiaris*)[1]

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Abstract

Many argue that dogs show unique susceptibility to human communicative signals that make them suitable for being engaged in complex co-operation with humans. It has also been revealed that socially provided information is particularly effective in influencing the behaviour of dogs even when the human's action demonstration conveys inefficient or mistaken solution of task. It is unclear, however, how the communicative nature of the demonstration context and the presence of the human demonstrator affect the dogs' object-choice behaviour in observational learning situations. In order to unfold the effects of these factors, 76 adult pet dogs could observe a communicative or a non-communicative demonstration in which the human retrieved a tennis ball from under an opaque container while manipulating another distant and obviously empty (transparent) one. Subjects were then allowed to choose either in the presence of the demonstrator or after she left the room. Results showed a significant main effect of the demonstration context (presence or absence of the human's communicative signals), and we also found some evidence for the response-modifying effect of the presence of the human demonstrator during the dogs' choice. That is, dogs predominantly chose the baited container, but if the demonstration context was communicative and the human was present during the dogs' choice, subjects' tendency to select the baited container has been reduced. In agreement with the studies showing sensitivity to human's communicative signals in dogs, these findings point to a special form of social influence in observational learning situations when it comes to learning about causally opaque and less efficient (compared to what comes natural to the dog) action demonstrations.

[1]

Introduction

One of the striking characteristics of 12- to 24-month-old human infants' social learning is that they are ready to imitate unusual ineYcient actions and replicate unnecessary aspects of the observed behaviour even if they themselves could use an obvious, more efficient method for reaching the same goal (MeltzoV 1988). Many investigations have targeted this "efficiency blindness", and researchers argued that early imitation is a blind and automatic copying process (Tomasello et al. 1993) that reflects the immaturity of causal understanding in infants (Dijksterhuis and Bargh 2001). In contrast, presuming a mentalistic interpretive stance in infants, others argue that infants attribute different goals and intentions to the demonstrator depending on their physical constraints (Bekkering et al. 2000; Carpenter et al. 2002). In line with this later approach, recent studies provided

evidence for the selective, inferential nature of the infants' imitation of goal-directed actions (Schwier et al. 2006; Gergely et al. 2002; Carpenter et al. 1998; Carpenter et al. 2002). Gergely et al. (2002), for example, found that when an unusual, less efficient action (switching a light box on with the head) is demonstrated in a manner that is cognitively opaque to the infant (there is no obvious reason why the demonstrator did not use her hand, the familiar and clearly more efficient alternative means action), 14-monthold infants are willing to re-enact the observed head action. In contrast, if the demonstrator was prevented from using the efficient solution due to obvious physical reasons (i.e. her hands were engaged), infants did not copy the demonstrated head action but selected a more efficient plausible method to reach the goal (i.e. they used their hands to switch the light on).

Regarding non-human animal species, recent findings suggest efficiency sensitivity in monkeys (Wood et al. 2007; Rochat et al. 2008) and selective imitation (copying less efficient action only if it is unexpected and does not Wt to the situational constraints) in apes (Buttelmann et al. 2007, 2008). Horner and Whiten (2005) found that chimpanzees are willing to copy when it is not obvious how the action will bring about a desired result, which means that the observed action is cognitively opaque. When the demonstrated action is causally irrelevant, they do not copy but choose an emulative solution. Dogs are also reported to show "infant-like selective imitation" (Range et al. 2007); however, in contrast to earlier studies (Topál et al. 2006), their imitative abilities have recently been challenged (Miller et al. 2009; Tennie et al. 2009). In addition to causal opacity, another factor that is thought to be important in the emergence of "efficiency blindness" and in the aforementioned selective responsiveness in imitation is whether the human demonstrator presents his/her action in an

ostensive–communicative–referential manner. Recent studies on infant social cognition provide convergent evidence indicating that young preverbal infants are prone to show special sensitivity and preference for a basic set of ostensive–communicative signals (such as direct eye contact, being addressed in motherese, turn-taking contingent reactivity—Ricciardelli et al. 2000; Cleveland and Striano 2007; Nielsen 2006; Senju and Csibra 2008; Yoon et al. 2008) and referential cues (such as gaze-shift or pointing—Teuscher and Triesch 2007; Senju et al. 2006; Grossmann et al. 2008; Tomasello 2008). It has been argued that human infants are biologically prepared to interpret such cues as expressing the other's overt communicative intention towards them to convey new and relevant information about referents (see Gergely and Csibra 2006; Gergely et al. 2007; Csibra and Gergely 2009). Clearly, such early sensitivity to communicative cues may provide a necessary cognitive prerequisite that supports preverbal infants' early emerging competence to engage in different types of triadic interactions, including social learning by imitation (Warneken and Tomasello 2007; Tomasello and Haberl 2003; Moll and Tomasello 2007; Moll et al. 2008). Ostensive–communicative and referential cues guide the infants' attention and influence their inferences and interpretations about the action demonstration so that they will

be more willing to imitate unusual and less efficient actions. In support of this view, it was found that ostensive–communicative demonstration context facilitates such responses as perseverative search errors (Topál et al. 2008). In addition to human infants, there is another species, the domestic dog (*Canis familiaris*), that reportedly possess special skills in utilizing ostensive–referential cues (for reviews see Topál et al. 2009a; Reid 2009). Dogs during their evolution in an anthropogenic environment (paralleled by the divergence from the wolf) have become selected to show increased sociality (Gácsi et al. 2005; Topál et al. 2005; Bräuer et al. 2006), co-operability (Miklósi et al. 2003) and communicability (Hare et al. 2002; Virányi et al. 2008; Gácsi et al. 2009).

In particular, recent results indicate that dogs have evolved a special preference for a wide range of cues of human ostensive and referential communication (such as eye contact, being verbally addressed, gaze-shift, body orientation and pointing—Bräuer et al. 2006; Gácsi et al. 2009). While direct eye contact typically functions as a threat cue in most animal species (e.g. Topál and Csányi 1994), dogs are unique among non-human animals to show sensitivity and preference for this ostensive cue of human communication (Kaminski et al. 2009; Topál et al. 2009a). For example, in two-way choice tasks in which dogs have a possibility to choose one of the possible hiding locations, subjects are biased to select the location mistakenly indicated by the human's ostensive–communicative referential cues especially if the human

demonstrator is present during choice (Topál et al. 2009b) and even if they had been unambiguously informed about the location of the reward (Szetei et al. 2003; Erdöhegyi et al. 2007). These results are of great importance because in line with other studies (Hare and Tomasello 2005; Hare et al. 2002), they point to the strong impact of human communicative cues on dogs' behaviour and suggest the hypothesis that dogs may also show evidence for infant-like context-dependent "efficiency blindness" in observational learning situations. Reviewing the recent literature, it is unclear, however, how the two potentially interacting factors, the ostensive– communicative signals of the demonstration context and the presence of the human instructor during the choice contribute to the emergence of the aforementioned efficiency blindness in the dog. Therefore, in this study, we investigated how the different combinations of these two factors affect the behaviour of dogs in a two-way choice observational learning task. In the demonstration phase subjects could see how a tennis ball can be retrieved from under an opaque container by the manipulation of a distant and obviously empty (transparent) one. Importantly, the situation was conflicting as subjects could either rely on the observed action (selecting the human-manipulated empty container) or emulate the goal by performing a more efficient alternative solution (selecting the baited container). On the basis of the recent findings, we assumed that for dogs, human ostensive– communicative cuing serves as a primarily imperative function by triggering a motivation to replicate the observed action. Moreover, as an imperative order is usually associated with a specific 'instructor' giving it, we could expect the highest tendency to rely on the human's less efficient action (manipulating the empty container) if it was not only accentuated by ostensive–communicative signals but the demonstrator personally remained present during the test phase.

Methods

Subjects

Dogs (*Canis familiaris*; *N* = 116) and their owners were recruited from various dog training schools in Austria and Hungary. Participation in the tests was voluntary and the only criterion for selection was that the dogs had to be highly motivated to play with a toy. Owners were instructed verbally before the experiment what to do and what to say during the demonstration and the test phases. Seven dogs were excluded from the final analyses due to technical reasons (inaccurate demonstration—4 dogs; problem with the recording—1 dog; the owner did not act in line with instructions—2 dogs). Thirteen dogs did not meet the selection criteria of the pre-test (see in "Procedure"), and there were twenty dogs that had passed the pre-test,

but were unwilling to participate in the test (totally lost interest in the task and did not make any choice). The dogs ($N = 76$, mean age: 3.8 years, range: 1–14 years) that were included in the final analyses were participated randomly in five experimental groups (see below). Each dog was tested only once. Subjects were from various breeds (52 purebred dogs from 40 different breeds and 24 mongrels). The overall sex ratio of dogs was balanced (38 males and 38 females).

Experimental arrangement

The experimental observations were carried out between June 2006 and August 2008. Dogs were tested either at the Department of Ethology, Eötvös Loránd University, Budapest ($N = 53$) or at the Department for Behaviour, Neurobiology and Cognition, Vienna University ($N = 23$). The same experimental setup and apparatus were used in both cases. A transparent and an opaque plastic container of similar shape and size (16 cm high and 16 cm in diameter) were placed 0.6 m apart. Both were turned upside down and placed on a black platform (20 Ł 20 Ł 6 cm). The white opaque container was used to hide the target object (a tennis ball). The platform was slightly aslope so that the tennis ball rolled down if the baited container was elevated. The two containers were connected by the means of a string, which was led through 2 pulleys that were fixed to the ceiling. An orange curtain covered the pulleys, and this was also used to prevent the dogs from witnessing some of the manipulations with the containers (see in "Procedure"). This apparatus makes the demonstrator possible to lift the opaque (baited) container by means of moving the empty transparent one horizontally (see Fig. 1).
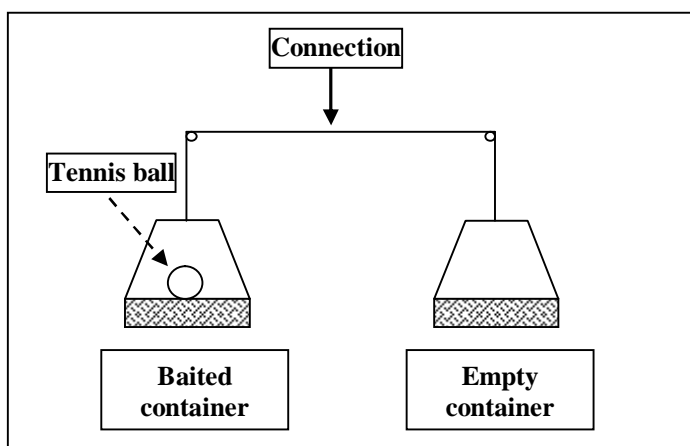

Fig. 1 Schematic representation of the experimental apparatus

Procedure

The procedure included three phases. First, we tested the dogs' motivation for participating in the task (Pre-test), then the human repeatedly (three times) demonstrated a less efficient solution of the task (i.e. she obtained the target object by means of manipulating the empty container - demonstration phase) and finally the dog was allowed to explore the experimental set up (Test trial).

Pre-test

The dog was led into the room and allowed to explore the room for 1 min while the demonstrator initiated a short play with the tennis ball. Then, the owner was asked to play a fetching game with the tennis ball. (S)he was instructed to throw the ball and to encourage verbally the dog to fetch it. Only those subjects were included in the experimental observations that retrieved the ball at least once out of the three fetching trials. A great majority of dogs (64 individuals out of 76) retrieved the ball each time, nine dogs were a bit less motivated (2 successful fetching trials) and there were only three ones that retrieved the ball only once. During this period, the experimental apparatus was covered by the curtain. Demonstration phase: Having been fulfilled the criterion of the pre-test, the dog was led by the owner to a predetermined point (at a distance of 3 m from the apparatus) and held it there by its collar. The demonstrator got the ball and placed it under the opaque container, while the curtain prevented the dog from witnessing the baiting procedure. Subjects were assigned in one of the five experimental groups so that the distribution of males/females and the mean age did not show significant differences between groups. Each group consisted of individuals from 8 to 9 different recognized breeds and 3–7 mongrels (Table 1).

Group	Demonstration phase:	Test phase:	Group size (Number of males)	Mean age (years) +SD	Number of different breeds (Number of mongrels)
OC-D/present	Ostensive-communicative demonstration	Demonstrator present	17 (6)	4.3 + 3.5	9 (7)
OC-D/absent		Demonstrator absent	17 (10)	4.2 + 1.9	9 (4)

NC-D/present	Non-communicative demonstration	Demonstrator present	14 (8)	2.5 + 1.9	9 (3)
NC-D/absent		Demonstrator absent	14 (8)	4.5 + 3.1	8 (5)
Non-Social	Remotely moved containers	Experimenter present	14 (6)	4 + 2.8	9 (5)

Table 1 Summary of the experimental conditions and subjects

Dogs witnessed the demonstrations in one of the following contexts

Communicative demonstration (Com) The demonstrator (a 25-year-old woman) who was standing between the two containers pulled back the curtains and looked at the dog. She addressed the subject ("[Dog's Name]! + Watch!"), and when the dog looked at her face, she bent her upper body and touched the two containers simultaneously. Then, she took an upright position and addressed the dog again („Look at this!"). At the moment, the demonstrator could make eye contact with the dog she crouched grasping the transparent empty container by both hands and placing it to the ground ahead of the platform (Fig. 2a). Thereupon, the baited container elevated and the tennis ball rolled out towards the dog. The demonstrator turned her head towards the ball shifting her gaze conspicuously from the dog to the ball. Finally, she picked the ball up and dropped it to the ground two times, but she did not give it to the dog. She closed the curtain and replaced the ball under the opaque container.

Non-communicative demonstration (NonCom) The procedure was identical to that described in the communicative demonstration condition, except for that the demonstrator performed the actions without ostensive–communicative signals (Fig. 2b). That is, she did not look at the dog and never addressed it. During the whole procedure, the demonstrator was mumbling a short poem. This was to attract the dogs' attention to the demonstration non-communicatively, without giving any direct instruction to the dog. The position of the baited container (left or right hand side) was counterbalanced between subjects in each group.

Test trial

Immediately after the third demonstration, the demonstrator closed the curtain and placed the ball under the opaque container. Then, she pulled back the curtains again and either left the room (*demonstrator absent* condition) or remained there (*demonstrator present* condition). In

the latter case, she was standing motionless at a predetermined point (on the left side of the dog). Once the demonstrator left or took her predetermined position, the owner released the dog and encouraged it (saying "You can go!" It's yours!") to explore and manipulate the apparatus. The trial was terminated after the dog approached and inspected both containers. If, however, the dog approached and/or inspected only one of the containers, the trial was terminated after 20 s. During this, the demonstrator did not talk to and did not look at the dog.

Non-social control condition In order to make sure that dogs are able to memorize and recall the location of the tennis ball after three demonstrations and the movement of the empty container itself is not sufficient to distract subjects, a group of dogs were observed in non-social context in which they could watch the moving containers without any human contribution. That is, in this condition, the experimenter did not participate in the demonstration as she was standing motionless behind the dog during the trials. Dogs could see the action demonstration (i.e. horizontal movement of the empty container and rolling the tennis ball out from under the elevated opaque container) without any direct manipulation by human as this was achieved by another human assistant moving the containers remotely (by means of fine nylon thread) from outside the experimental room. Subjects' attention was attracted to the moving containers by the means of non-social sound effect (small hidden bells that were fixed to the string close to the containers). After the tennis ball had rolled out the Experimenter went to the apparatus, she picked the ball up and dropped it to the ground two times, but she did not communicate and did not give it to the dog. Then, she closed the curtain and replaced the ball under the opaque container. Finally, she went back and stood behind the dog. The whole session was videotaped by two cameras (one facing the subject and one facing the experimental apparatus), and the behaviour of subjects was analysed later. Data collection and analysis A container was regarded as chosen if the dog turned it over or touched it with its paw/muzzle or at least approached it (its paw/muzzle was closer than 5 cm to the container). To assess inter-observer agreement, a second person blind to the demonstration condition scored a randomly selected sample of 63%. Cohen's kappa value was 0.904, showing a high level of reliability. There were only 2 disagreements between the two coders: 1–1 in the Com-D/ present and NonCom-D/not present conditions. In both cases, the second coder categorized the dogs' response as "empty". In these cases, the dogs' choice behaviour was ambivalent: they approached the empty container, but while passing by the empty container, they turned their head towards the baited one—so their nose was not closer than 5 cm to the empty container. Moreover, right after passing by the empty container, these dogs approached directly and touched the baited one. The two coders discussed these cases of

disagreements and finally they accepted the first coder's evaluation ("baited"). We recorded three variables: (a) the first choice (i.e. whether the dogs inspected first the baited or the empty container) (b) the shift between the locations (i.e. whether they proceeded to the other container after one had been visited) and (c) the latency of the firstly selected container (i.e. the time elapsed between the moment the owner released the dog and it approached one of the containers). For the analysis of the dogs' first choice, we employed binomial tests to see whether there was significant bias towards the empty or baited location within the groups and the effects of demonstration context (communicative vs. non-communicative), and the presence of demonstrator during the test trial on the dogs' first choices was analysed by Generalized Linear Model for binary data (SPSS, version 17). Normality tests (Kolmogorov–SmirnoV) for the latency data did not show significant deviations from normal distribution in any of the five experimental groups, however, the differences among standard deviations were significant (Levene's test; $P = 0.016$). Thus, we employed reciprocal transformation ($1/x$) for the raw data and then latencies of the dogs' first choice in the five groups were analysed by univariate ANOVAs. Finally, to check whether dogs actually did attend to the presentation equally across demonstration contexts, we also coded the subjects' attentiveness on the basis of their head and gaze orientation. To this, we discriminated gazing towards the human demonstrator and gazing towards the baited container. Turning the head to any other directions was coded as "looking away".
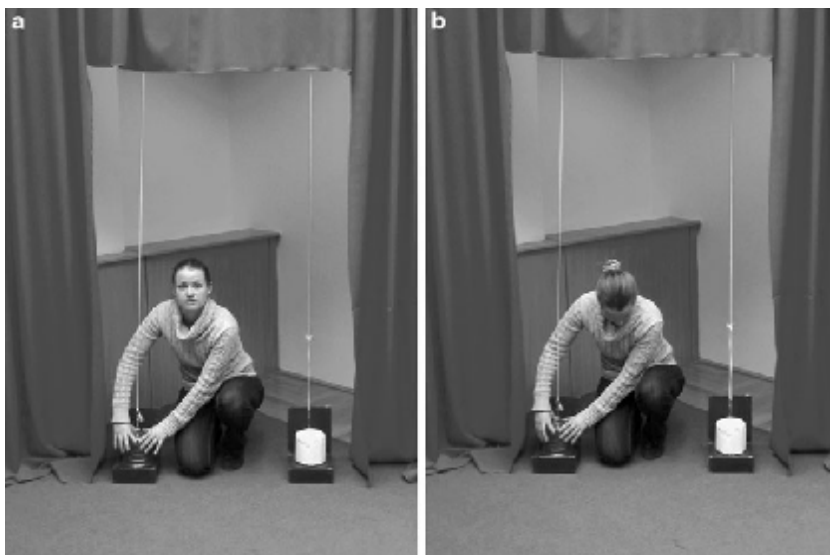

Fig. 2 Photo illustration of the **a** Communicative demonstration *(Com)* and **b** Non-Communicative demonstration *(NonCom)*

Results

In order to characterize the dogs' "baseline" task performance, first we analysed the choice behaviour of subjects in the non-social control condition. Dogs were ready to participate in the task, they made their first choice within a few seconds (mean latency = 3.7 s). In most cases (11 out of 14), the firstly selected container was the baited one, and this tendency was marginally significant (binomial test, $n = 14$, $P = 0.057$). The preference for the baited location is further supported by the finding that all individuals inspected the baited container and many of them (6 dogs) visited only the baited one (i.e. did not proceed to the empty container). However, none of the subjects could retrieve the ball in this group. In the social demonstration contexts, in which we tested the effects of the communicative signals and the presence of the demonstrator in a 2 x 2 experimental design, dogs showed an overall preference for the baited container. In 72.6% of the total trials, they first inspected the baited container (binomial test, N = 62, p < 0.0001) and there were only seven dogs (11.3%) who did not visit the baited location. A group by group analysis of the firstly selected container showed that the presence or absence of the demonstrator during choice had no influence on dogs' first choice in the non-communicative demonstration contexts (subjects preferred to choose the baited container in both NonCom-D/present and NonCom-D/absent conditions; binomial test, p = 0.002 for both).

However, after having watched a communicative demonstration, dogs showed the same selection bias only when the demonstrator was absent (binomial test, p = 0.049) but not when she was present (binomial test, p = 0.332) (**Fig. 3).**

The GLM analysis of the dogs' first choice as a function of both independent variables (presence or absence of the human's communicative action; presence or absence of the demonstrator during choice) showed significant effect of the demonstration context (Com vs. NonCom; $chi^2(1) = 7.585$, p = 0.006). In contrast, neither the presence of the demonstrator (D/present vs. D/absent; $chi^2(1) = 1.163$, p = 0.281) nor the interaction of the two factors proved to be significant ($chi^2(1) = 1.163$, p = 0.281). During the test trial, dogs had a possibility to approach and inspect both containers, or they could select only one of these. Based on these possibilities subjects were categorized in one of the three response categories (i.e. "empty only", "baited only" and "both"—see **Table 2).**

	Container inspected by the dog		
Groups	Empty Only	Baited Only	Both
OC /D-present	35.3%	17.6%	47.1%
OC /D-absent	5.9%	35.3%	58.8%
NC /D-present	0%	64.3%	35.7%
NC /D-absent	0%	71.4%	28.6%
NS	0%	42.9%	57.1%

Table 2 Proportion of dogs inspecting only the baited, only the empty, or both containers during the test trials
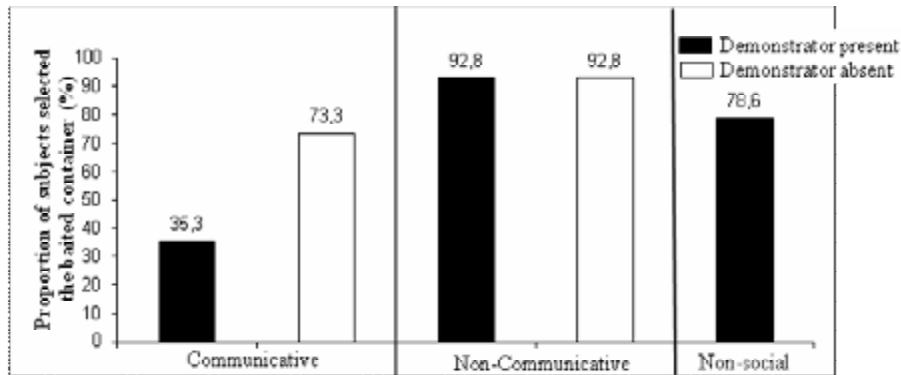

Fig. 3 Percentage of dogs approaching and inspecting the baited container first in the different demonstration contexts. **p < 0.01; *p < 0.05; (*) p < 0.06 in comparison with the success rate expected by random search (binomial tests)

Results show that compared to other experimental groups, those subjects who were tested in the presence of the demonstrator after having witnessed ostensive–communicative demonstrations (Com-D/present group) showed different distribution across the three response categories. The "empty only" response was observed only in the ostensive–communicative demonstration contexts (in these two groups 7 out of the 34 individuals inspected only the empty container). It is also important to note that majority of these subjects (6) were from the "demonstrator present" condition and only one dog did so when the demonstrator was absent (Com-D/present vs. Com-D/absent: Fisher's exact test, $P = 0.085$). Nevertheless, only some individuals (Com-D/present: 2 individuals out of 17, Com-D/absent:

6/17, NonCom-D/ present: 4/14, NonCom-D/absent: 1/14) could retrieve the tennis ball by pushing over the baited container during the test trial (comparison across conditions: Kruskal–Wallis Test, $chi^2(4) = 9.351$, p = 0.053). None of them could retrieve the ball by manipulating the empty side. Finally, we found that all 76 dogs followed the demonstrations with full attention (i.e. they never looked away for longer than a second during the three trials, and the majority of them (74) shifted their gaze towards the baited container at the moment when the tennis ball rolled out in at least 2 out of the 3 trials. Only two dogs were that turned their heads only once towards the baited container out of the three trials when the ball emerged from under it. This fact and the finding that we did not find significant differences between groups in terms of their latency of approaching and inspecting the apparatus ($F4,71 = 0.409$, $P = 0.802$, **Fig. 4**) provide strong support for that differences between the conditions could not be explained by differential attention and/or motivation for participating in the choice task.
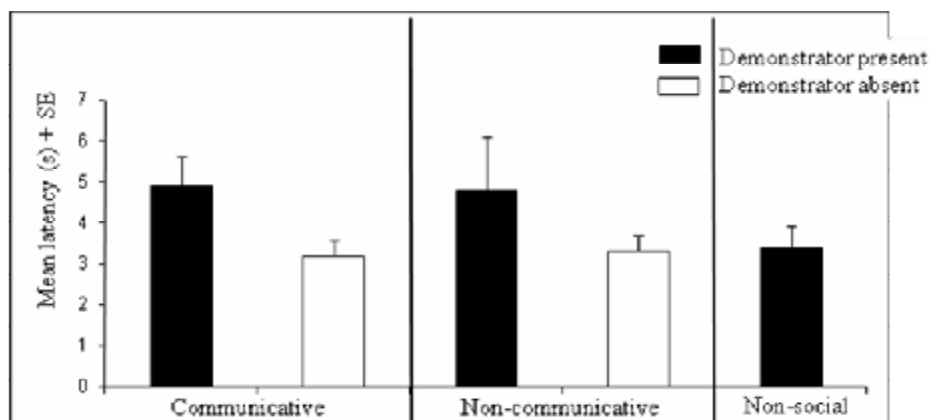

Fig. 4 Mean latency (s) of approaching the apparatus in the different demonstration contexts. *Error bars* represent *SEM*

Discussion

In this study, we investigated whether dogs show infant-like "efficiency blindness" in an observational learning situation depending on the ostensive–communicative signals from human demonstrator and the presence of the demonstrator during their choice.

Actually the task presented here for the dogs was not demanding cognitively. There were only two possible alternatives: a transparent container, which was clearly empty, and a non-transparent one under which an attractive toy object was hidden (and the dog was repeatedly informed about this fact). What makes the task a bit more complex for dogs was that the location of the reward and the human manipulation were spatially separated because during

the demonstration phase the toy object repeatedly emerged from under the non-transparent container by moving the transparent one. It seems that the unusual and causally opaque demonstrations in general cannot distract the dogs' attention from the goal and cannot inhibit the dog from approaching the baited container directly. Binomial tests revealed that in 3 out of 4 experimental contexts (Com-D/ absent, NonCom-D/present, NonCom-D/absent) as well as in the non-social control condition significant proportion of the dogs (73–93%) visited the baited container first. These findings suggest that subjects could recall the place of the reward, they were motivated to retrieve it and were not distracted or misled by the moving empty container and/or by the human's 'misleading' actions.

Although in general dogs preferred the simpler, evident solution (direct approach) over the less efficient demonstrated one, there was a combination of the situational factors that led to a reduced tendency of goal directedness. Namely, when human manipulated the empty container expressing her overt communicative intention towards the dog and she was still present during the testing phase (Com-D/present), subjects did not show significant bias to the baited container. It seems therefore that after having observed communicative manipulation of the empty container the presence of the demonstrator has some influence on the dogs' choice behaviour. This effect, however, seems only marginal as the overall (GLM) analysis revealed a significant main effect of the demonstration context (presence or absence of social communicative cues), but no main effect of the demonstrator's presence during the test phase. One possible explanation of these results is based on a motivational account. Recent evidence suggests that in social learning situations ostensive–communicative cues may trigger higher levels of arousal and activity in dogs (Range et al. 2009a). Thus, one may assume that the change in the dogs' search pattern lies in the differential motivational effect of the different demonstration conditions. That is, dogs were better motivated to participate in the task (they were more willing to approach and inspect the apparatus as a whole) in the communicative demonstration conditions and this, incidentally, led to a higher probability of visiting the empty container. This account, however, is not supported by the latency data showing that dogs made their choice shortly after having released (within 3–5 s on average) in each condition, and there were only three dogs out of the 76 (2 in Com-D/present and 1 in NonCom-D/present groups) that did not make their first choice within 10 s. This suggests that although dogs were similarly motivated to participate in the task, there could be specific differences in their decision-making processes across contexts. Another explanation can be raised on the basis of the dogs' attention and memory processes. Recently, it has been shown that attention is an important variable when testing dogs in social situations (Range et al.

2009b). In line with this, one may suppose that signals expressing the demonstrator's communicative intent focused the dog's attention to the steps of demonstration and therefore enhanced the capacity of the dog to encode the human's actions during the observation and display more effective recall during choice (see also Pongrácz et al. 2004). Moreover, the presence of the human demonstrator in the testing phase probably acted as a 'reminder cue', which facilitated recalling the demonstration. It follows from these that the presence of the human demonstrator in the test phase and the communicative signals as a part of the demonstration could have had an independent (additive) effect leading to a decrease in goal-directed search behaviour (selecting the baited container). Importantly, our results do not seem to support this account as we could find only marginal effect of the human's presence during the test phase on the dogs' choice behaviour.

A further potential explanation may be linked to the phenomenon of local enhancement, a learning mechanism by which a particular location is made more salient to an individual by various means involving social communicative cues. Some studies have reported that dogs show a tendency to carry out a counterproductive response in object choice situations if one location is misleadingly indicated by the human communicative cues (Szetei et al. 2003; Erdöhegyi et al. 2007; Prato-Previde et al. 2008), and this strange social influence of the human on dogs' performance may stem from the local enhancement mechanism. In our study, however, local enhancement account is not fully supported by the results. First, although there was a clear difference between the non-social control and non-communicative demonstration contexts as regards the saliency of the empty container, the different local enhancing effect is not reflected in dogs' choice response. Finally, we can offer a social communicative account, for the findings we found. In our experiment, human demonstration might have two possible roles: acted as triggering and facilitating either a preference for obtaining the desired object in the most effcient way or rather to act in line with the human demonstration. In the former case, the demonstration could be perceived as not having communicative flavour and moving of the empty container simply informed the dog about the goal of the task ('there is a ball under the opaque container'). Results show that dogs in the non-communicative demonstration contexts mainly utilized this kind of emulative meaning of the observed demonstrations and they preferred the effective, species-specific solution (approaching the baited container directly). However, the human's demonstration could also be perceived as communicative manifestation that acted as not only making the subject to recognize the location of the reward but manifesting a specific behaviour. This raises the possibility that the demonstration of this causally opaque, inefficient action was regarded as a communicative

manifestation of an 'episodic imperative' by the human ('Go to the empty container!'). Actually, it seems that in those conditions in which demonstrations were accompanied by the human's communicative signals, especially if the human demonstrator remained present during test trials, dogs showed some tendency of using the human referential cues to specify the spatial location where the act was required to be performed, and as a consequence, they selected the baited container less frequently in comparison with other demonstration contexts. It is also important to note that dogs typically show a predisposition towards engaging in joint activities with humans and they frequently request human help if a problem is insoluble (e.g. Miklósi et al. 2003). Moreover, dogs may be able to recognize components of how humans need to behave to produce the desired result without understanding the causal relations involved in the process (e.g. human moves object that activates pulley). In line with this, dogs' responses in this experiment can not only be interpreted as behaviours intended towards producing a solution to the problem themselves but a situation involving collaboration. The notion that dogs tried to use the human demonstrator as a "social tool" to reproduce the desired result is supported by the observation that only a few (2–6) dogs obtained the reward on their own in the different experimental conditions as if they were waiting for the human's help in spite of the fact that retrieving an object from under an opaque container is motorically not a demanding task for a dog. In addition to providing further support for the importance of the social communicative signals in observational learning situations, the results of the present study raise the possibility that like in infants (Király 2009), the presence of the human demonstrator also plays some behaviour modulating and constraining role in observational learning situations when it comes to learning about causally opaque and less eYcient (compared to what comes natural to the dog) action demonstrations. In certain situations, dogs' behaviour is probably driven by a motivation to satisfy ostensively signalled human imperatives in the 'here-and-now' (Topál et al. 2009b) and the ostensively communicated human action demonstrations can be functionally interpreted as imperatives by dogs with the function of performing the observed action in the presence of (and 'for') the human demonstrator. In agreement with the studies showing specific sensitivity to human's communicative signals in dogs (Erdőhegyi et al. 2007; Kaminski et al. 2009; Riedel et al. 2008), we propose that for the dog, the function of human demonstration is not (only) transferring knowledge but disposing behaviour actions. Supposedly, this form of social influence has been evolved to evade conflicts in the group and to co-operate in common actions without any deeper insight into the knowledge content of other's mind. Nevertheless, future studies are needed in order to reveal, whether the influential effect of communicative

signals of the demonstration context on dogs' choice actually reflected their willingness to follow a specific order or communicative cueing and other contextual factors simply distracted them from the more effective, emulative solution.

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