Behavioural Processes xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Behavioural Processes

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

Do more sociable dogs gaze longer to the human face than less sociable ones?

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ARTICLE INFO

Article history:
Received 7 October 2011
Received in revised form 5 January 2012
Accepted 27 January 2012

Key words:
Sociability
Gaze
Interspecific communication
Learning
Domestic dogs

ABSTRACT

Domestic dogs (*Canis familiaris*) are especially skillful in communicating with humans, and they rely on special abilities to do that. One of these skills involves gazing at human faces in cases of uncertainty or when seeking for something out of reach. In this study, we evaluated the relationship between dogs' sociability level and the ability to learn to gaze in a situation with food in sight but out of their reach. Thirty-nine adult dogs were tested in two procedures: (1) a sociability test that involved interacting with an unknown person, and (2) a learning task that consisted of training trials in which gazing at the experimenter's face was food reinforced, followed by extinction trials in which gazing was not followed by food. A significant positive correlation was found between the duration of physical contact with the unknown person in the sociability test and gaze duration during extinction. Moreover, high sociability dogs gazed significantly longer at humans during extinction trials. We discuss the possibility that, more sociable animals, such as those who pay more attention to the person in our sociability test, may be more persistent in their communicative attempts because the presence of the human is intrinsically reinforcing to them. Finally, we comment on the importance of these findings for training purposes.

1. Introduction

One of the most important non-verbal behaviors in human communication is gazing. Gaze direction is a critical facial cue in everyday interaction, because it provides a wealth of socially relevant information about people's goals and their environment (Ethofer et al., 2011). Many other species beyond humans also use the gaze for intraspecific interactions (e.g., nonhuman primates, Tomasello et al., 1998; goats, Kaminski et al., 2005; wolves, Range and Virányi, 2011). Distinctively of domestic dogs, however, is that they rely on this social signal to communicate interspecifically with humans. When dogs are faced with a situation they cannot solve by themselves, they tend to gaze at their owner's face, who usually reacts by helping them to solve the problem (Gaunet, 2008, 2009; Marshall-Pescini et al., 2009). It has further been shown that dogs can indicate to a human the location of a hidden target by alternating its gaze between the object and the human's face (Miklósi et al., 2000; Virányi et al., 2006) and that they look referentially to the owner after a strange object suddenly appears (Merola et al., 2011). Additionally, Miklósi et al. (2003) found that dogs looked longer at their caregivers when prevented from accessing food in a way they had previously learned relative to socialized wolves. Moreover, dogs and 12–14-month-old human infants engaged in a similar unsolvable task did not differ in the duration of their gaze toward a nearby human adult (Prato Previde et al., 2011).

Previous evidence showed that gazing can be modulated by associative learning processes. Bentosela et al. (2008) by means of a situation involving food in sight but out of dogs' reach, demonstrated that gaze duration toward the experimenter's face significantly increased with just three reinforcement trials and also quickly diminished when it was no longer reinforced (extinction, omission). However, not all dogs showed the same performance in this task. Individual differences were observed during extinction trials: retriever breeds gazed longer at the human face than shepherds and poodles (Jakovcevic et al., 2010) and family dogs gazed longer than shelter dogs did (Barrera et al., 2011). Likewise, individual differences in dog's human-directed gazing were also observed in other tasks. For instance, previously encouraged dogs (by verbal reinforcement) looked longer at their owners than non-encouraged dogs (Horn et al., 2011). Agility trained dogs gazed longer than dogs trained for searching and rescuing tasks which in turn gazed longer than untrained dogs (Marshall-Pescini et al., 2009): besides, schutzhund trained dogs also presented more gazing than untrained dogs (Bentosela et al., 2008). In addition, adult dogs spent more time gazing at the person than 4.5-month-old puppies (Passalacqua et al., 2011) and differences according to dog's breed have also been reported (Pongrácz et al., 2005; Jakovcevic et al., 2010; Passalacqua et al., 2011).

To our knowledge there are no previous studies relating individual differences in temperament and gazing behavior in dogs.

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doi:10.1016/j.beproc.2012.01.010

Given the importance that gazing behavior has in the relationship between dogs and humans, it is relevant to evaluate individual differences in the sociability level of these animals. Sociability has been defined as the animal's interest and attitude toward another member of its same species or toward humans (Svartberg, 2007). A common test of interspecific sociability consists of an encounter of the dog with an unknown human, who may act passively or actively. In the first case, the person can remain indifferent to the dog in an unfamiliar place (Weiss and Greenberg, 1997; Hennessy et al., 2006; Batt et al., 2008) or, in the case of shelter dogs, approach the kennel and put his hand inside it (Weiss and Greenberg, 1997; Valsecchi et al., 2011). In both cases, the dog's spontaneous approach toward the human is observed. In the active approach, however, the dog's reactions to the experimenter's initiatives are also registered. The human initiative can involve approaching, petting (Weiss and Greenberg, 1997; Svartberg and Forkman, 2002; Barrera et al., 2010), speaking or calling the dog by its name (van der Borg et al., 1991; Lucidi et al., 2005; Vas et al., 2005), as well as touching its body or taking it for a short walk (Svartberg and Forkman, 2002). Sometimes a combination of these actions is used (e.g., De Palma et al., 2005; Valsecchi et al., 2011).

The main goal of this study was to evaluate the effect of sociability on a learning task involving gazing toward a human face to ask for food. Sociability was therefore evaluated by means of a behavioral test and then, the performance of the groups with extreme values in this dimension was compared in a task where dogs had to gaze at the human to access the food which was out of their reach (see Jakovcevic et al., 2010). In addition, a validated questionnaire about canine behavior (C-Barq; Hsu and Serpell, 2003) was administered to a subgroup of owners to evaluate the possible associations of sociability measures of dogs' behavior with the owners' reported stranger-directed fear, non-social fear, attachment/attention seeking and trainability of their pets.

Since the learning task used implies a dog–human interaction and there is previous evidence suggesting that in humans gazing behavior is related to social personality traits (extraversion, Kendon, 1967; Wiens et al., 1980; social anxiety, Wieser et al., 2009; Schneier et al., 2011; shyness, Iizuka, 1994; affiliative needs, Exline, 1963) we hypothesized that in the case of dogs, interspecific sociability would also be related to gaze duration toward a human. Specifically, more sociable dogs would gaze longer at humans than less sociable ones.

2. Materials and methods

2.1. Subjects

Forty-four dogs (*Canis familiaris*) were used. They all lived in family households and were evaluated with their owners' consent. None of them had previous training.

Four dogs were excluded from the analyses due to technical reasons (interruptions during the sociability test) and one dog did not meet the selection criteria of the communicative task (to gaze at the experimenter at least four times during each acquisition trial, see in Section 2.2.2.2).

The dogs ($N = 39$, mean age: 4.06 years, range: 1–11 years) that were included in the final analyses participated in both parts of the procedure. Subjects were from various breeds (1 beagle, 6 golden retriever, 3 labrador retriever, 1 boxer, 2 brittany, 1 schnauzer, 1 great dane, 2 cocker spaniel, 7 German shepherd, 8 poodle and 7 mixed breeds). The overall sex ratio of dogs was 24 males and 15 females. In turn, a subsample of 22 owners (mean age: 37.5 years, range 22–67; 3 male, 19 female), answered the translated version of Hsu and Serpell's (2003) C-Barq questionnaire.

2.2. Procedure

The procedure was divided into two parts: sociability test and communicative learning task. They were always carried out in this order and on the same day, with a minimum interval of 15 min (mean = 19.8 min; range: 15–60 min). The fixed order of procedures was to ensure the assessment of the animal's initial reaction to the presence of a stranger in the sociability test. Each part was performed by different female experimenters (E) who were unknown to the dog. Both parts were scheduled in an indoor location familiar to the dogs. Nineteen dogs were evaluated in a room of the owner's house, the remaining in a training/boarding establishment that was familiar to the dogs.

2.2.1. Sociability test

To accurately evaluate sociability level and in order to differentiate more sociable dogs from less sociable dogs, a behavioral test was carried out based on the protocols published by Svartberg and Forkman (2002), Hennessy et al. (2006), Batt et al. (2008) and Barrera et al. (2010). This procedure comprised two interaction modalities by the experimenter (passive–active), so as to obtain indicators of the animal's spontaneous interest and of its reactions to human's initiatives.

The test was carried out in a closed room where there was a chair placed against a wall. Tape marks on the floor 1 m away from the chair were used to later determine the distance kept by the dogs. Only the E and the dog were present during testing. The owner was not present. The E was the same unfamiliar woman for all dogs. The situation was videotaped by a camera (Sony DCR TRV 310) located on a tripod.

The test began after allowing the dog to explore the place and apparatus for about 5 min. It was divided into two 2 min phases. (a) Passive phase: the evaluation started when an assistant left the dog inside the room where an E, stranger to the dog, was reading, sitting on the chair. If the dog made physical contact with her, E petted it only once and then withdrew her hand. During this phase, visual contact was avoided. After 2 min, the second phase began. (b) Active phase: E stood up, left her book on the chair, made visual contact with the dog and called it by its name (whether it was near or far). If the dog approached, E interacted by petting and talking to it. If the dog did not approach, E called him three times at 10 s-intervals. If the dog approached and then went away, E called it up to three times. During this second phase, E stayed still in the same place to avoid possible fear reactions in the dog.

2.2.1.1. Sociability measures. The following variables were registered:

- Contact latency (s/cm), measured from the time the animal enters the room until it makes physical contact with the E for the first time. Latency was divided by the distance from the door to the E in cm.
- Time (s) close to E (<1 m distance). Time close (TC) was registered during passive (TC passive) and active phases (TC active).
- Physical contact (PC), duration (s) of the physical contact between the E and the subject. It was registered during passive (PC passive) and active phases (PC active).

2.2.2. Communicative learning task

The apparatus and procedure were similar to the one used in Jakovcevic et al. (2010). Incentives were placed in a container located on a high shelf. The container was visible to the animals, but out of their reach. E stood next to the food. All trials were videotaped. The person taping the trial was located behind and on one side of the E, so as to be able to film the direction of the dog's

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gaze and head. Sessions were scheduled in the same area of the sociability test.

Dogs had free access to water and the last meal before training sessions had been received approximately 7 h earlier.

The reward was dry liver. Each session involved the dog, the E, and the assistant operating the camera. Owners were not present. The procedure consisted of three phases: warm-up, acquisition and extinction.

2.2.2.1. Warm-up. The E called the dogs by their names and actively sought physical contact. To evaluate dogs' motivation for food, they received three units of liver, directly from the hand of E. All dogs accepted food.

2.2.2.2. Acquisition. Immediately after warm-up, dogs received three trials of differential reinforcement of gazing at the experimenter. Each trial lasted 2 min with an inter-trial interval (ITI) of approximately 2 min. Acquisition trials started with E standing by the food container and calling the dog by its name just once. Dogs were reinforced each time they gazed at E's face. From the second trial, dogs were required to gaze at E's face at least 1 s before receiving a reward.

Usually, dogs moved their gaze from E's face to her hand as soon as E reached for the food. A new reinforcer was delivered when the dog turned its gaze back to E's face for 1 s. At the end of each trial, E withdrew to a different room, out of the dog's visual field, while the dog remained in the training area. A selection criterion where dogs had to respond to their names and to gaze at E at least four times during each acquisition trial was established. Only one dog did not reach this criterion and was eliminated.

2.2.2.3. Extinction. Three extinction trials, 2 min each, were performed with a 2-min ITI. The interval between acquisition and extinction phases lasted 2 min. This phase was identical to the acquisition one except that the reward was never delivered. It started by calling the dog by its name once, but without giving it any food. E and the food remained in the same place as in previous trials. At the end of each trial she left the area.

During acquisition and extinction trials E remained in the same position gazing at the dog's face. For the communicative task E was always the same woman, different from the one that acted on the sociability test.

2.2.2.4. Communicative learning task measure. Gaze duration (s) was measured as a dependent variable. The cumulative duration of visual contact of the dog with the trainer was scored on all trials. Each time dogs directed its head/gaze to E's face the stopwatch was activated, alternatively when they changed head/gaze direction it was stopped.

2.2.3. C-Barq questionnaire

We administrated the translated version of Hsu and Serpell (2003)'s C-Barq. Owners completed it in a different place while their dogs were being evaluated. This questionnaire identifies a total of 11 subcategories, seven of which have been validated as diagnostic categories (stranger-directed aggression; owner-directed aggression; dog-directed aggression/fear; stranger-directed fear; non-social fear; separation-related behavior; attachment/attention seeking) and the remaining four refer to specific experiences in the dogs' life (trainability; chasing; excitability; touch sensitivity). Of these subcategories we chose to focus on four of them. In order to analyze if the sociability test was an adequate measure of sociability (Diederich and Giffroy, 2006) its relationship with *stranger-directed fear* category was evaluated. This is linked to the tendency to respond with fear when a stranger approaches directly. To test discriminant validity, correlations with *non-social fear* were calculated, this variable was defined as the tendency to react with fear to sudden or loud noises and to unfamiliar objects or situations. To check the specificity of the sociability measure associations with *attachment/attention seeking* (i.e., the tendency to keep closeness to the owner and to other members of the family, ask for affection and attention and become agitated when the owner shows affection to others) was tested. Finally as gazing at humans improve learning of social cues (Braem and Mills, 2010) the association with *trainability* (i.e., readiness to obey the owner, follow simple commands, return objects, respond positively to corrections and ignore distracting stimuli) was also evaluated.

2.2.3.1. C-Barq measures. To calculate the score of each of the four subscales of C-Barq, the value of each item was added and the total was divided by the number of answered items.

2.3. Data analysis

Two observers (the first author and a naïve observer) analyzed the sociability measures and gaze duration in 100% of the videotaped material by manually calculating (with a stop watch). To test inter-observer reliability Pearson's coefficients of correlation were calculated for the sociability measures ($r_s > 99$, $N_s = 5$, $p_s < .05$) as for gaze duration for all the dogs ($r_s > .99$, $N_s = 39$, $p_s < 0.01$).

The five sociability variables (contact latency, TC passive, TC active, PC passive and PC active) did not show a normal distribution (Kolmogorov–Smirnov test, $p_s < .05$), therefore non-parametric tests were used for its analysis. Differently, gaze duration was found not to differ from normal distribution (Kolmogorov–Smirnov test, $p > .05$).

To test the validity of the sociability test, Spearman-rank correlations were performed between sociability and C-Barq measures. Before evaluating the effect of sociability over gaze duration, Spearman-rank correlations between the five sociability variables and gaze duration in all trials were performed. Then, in order to evaluate the effect of sociability on gaze duration, two extreme groups (see below) according to their sociability level were compared by means of two ANOVAs (one for acquisition phase and another for extinction phase) with sociability group (high vs. low) as between-subject factor and trials as within-subject factor.

To evaluate whether other potentially relevant factors, such as gender and place of training (owner's home vs. training/boarding place) affect gaze duration, a repeated measures ANOVA for each factor in the acquisition and extinction phases was performed. To control the effect of these two factors over sociability variables, Mann–Whitney *U*-tests were used. Age effects were analyzed by means of Spearman-rank correlations between subject's age (in months) and the five sociability variables and also with gaze duration. The alpha value was set at .05. All analyses involved two-tailed tests.

3. Results

3.1. Correlations between sociability and C-Barq variables

Correlations between the C-Barq and the sociability measures showed that those dogs that scored higher in stranger-directed fear showed a longer contact latency ($Rho_{21} = .54$, $p = .009$) and spent less TC during the passive phase of the behavioral test ($Rho_{21} = -.46$, $p = .029$).

This suggests that contact latency and time close to E during the passive phase are related to fear of strangers reported by its owners. In turn, those dogs with higher scores in trainability showed a higher duration of PC passive ($Rho_{21} = .49$, $p = .021$) and more TC passive ($Rho_{21} = .48$, $p = .023$) in the behavioral test. These associations suggest a relationship between dogs' sociability and their

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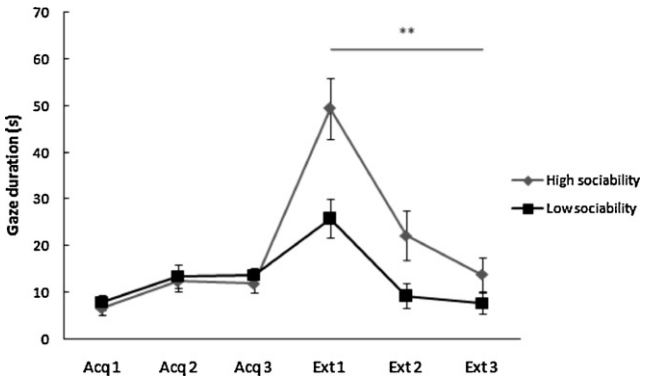

Fig. 1. Gaze duration (s) during each trial for each group. Dogs were required to gaze at the trainer for 1 s to receive food (means ±SEM). High sociability group gazed significantly more during extinction, $^{**}p<.01$.

ability to attend and obey to owner's commands. The remaining correlations were non-significant ($p_s > .05$).

3.2. Correlations between sociability measures and gaze duration

Only one significant association was found. PC passive was positively associated with gaze duration in the first extinction trial of the communicative task (Rho(39) = .36, $p < .05$). The remaining correlations regarding contact latency, TC passive, TC active and PC active with gaze duration were non-significant ($p_s > .05$). This indicates that those dogs that spent more time in physical contact with the stranger when she was passive, gazed longer at the human face during extinction. On the basis of that association, the sample was split into two groups according to their values in PC passive (low sociability group; subjects under percentile 25, $n = 9$ vs. High sociability group; subjects over percentile 75, $n = 9$; see Appendix A).

In turn, Mann–Whitney *U*-tests confirmed that these groups significantly differ in all sociability variables (see Table 1).

3.3. Effect of sociability on gaze duration

Fig. 1 shows gaze duration during acquisition and extinction trials for both groups. During acquisition phase, gaze duration significantly increased across trials, $F_{2,32} = 17.36$, $p < .001$. Nevertheless, sociability group effect, $F_{1,16} = 0.69$, $p > .05$, as well the interaction of group and trials, $F_{2,32} = 0.064$, $p > .05$, were non-significant. This indicates that the animals significantly increased gaze duration during acquisition trials regardless of their sociability level.

Differently, regarding extinction there were significant effects of Trials, $F_{2,32} = 38.59$, $p < .001$, sociability group, $F_{1,16} = 8.82$, $p < .001$, and of the interaction group and trials, $F_{2,32} = 3.59$, $p = .009$ (see Fig. 1). These results show that during extinction trials, though both groups reduced their gaze at humans, those of low sociability gazed significantly less than those of high sociability in all the trials, showing a greater extinction of the response.

Finally, there were no significant effects of place of training or sex on gaze duration, contact latency, TC passive, TC active, PC passive nor PC active ($p_s > .05$). Neither there were significant associations between subjects' age and gaze duration nor between age and any of the sociability measures ($p_s > .05$).

4. Discussion

The purpose of this study was to evaluate dogs' sociability differences in gazing to a human face in a situation in which food was present but out of animals' reach. Results showed that more sociable dogs gazed longer at the experimenter than less sociable ones during extinction trials. This gives support to our hypothesis and highlights the importance of this temperament trait in dog–human communication. As far as we know, this is the first evidence showing the influence of sociability in modulating an interspecific communicative response.

There are several explanations for these results. First, more sociable dogs may be more predisposed to interact with people, thus increasing the opportunities of being reinforced by gazing at humans. Likely, high sociability would not only reflect a difference in temperament but also a history of more frequent reinforcement. Second, high sociability dogs may be more persistent and resistant to the extinction of learned responses. Differences in persistency could be tested by comparing high and low sociability dogs in different learning tasks involving operant responses other than gazing. Third, it is possible that the presence of the human who sustained visual contact with the dog in extinction trials acted as a social reinforcer, thus maintaining the communicative response of more sociable dogs when they no longer receive food. For less sociable dogs, the presence of the human would be less reinforcing or even threatening, which could explain why these dogs stopped gazing sooner during extinction.

These results agree with those found in studies with humans, where visual contact was associated with sociability-related tendencies (e.g., Wieser et al., 2009; Schneier et al., 2011). In this sense, Burgoon et al. (1986) state that gazing would have activating properties, and since extroverts can tolerate a higher level of external stimulation, they maintain their gaze longer during social interaction. In contrast, introverts tend to avoid eye contact during these interactions.

It is worth highlighting that probably, the absence of a sociability effect during the acquisition phase, may be due to the fact that food is so valuable for dogs that all of them developed the response, independently of their sociability level (a ceiling effect). However, the lack of differences among groups may also be associated with the characteristics of the acquisition procedure. During acquisition trials, animals interrupt visual contact to eat, and thus the total time they have for gazing is reduced, which may diminish the chances of detecting sociability differences that do appear during extinction. This idea finds support in the fact that other factors, such as breed (Jakovcevic et al., 2010) and socialization experiences (Barrera et al., 2011) also modulate gazing in extinction but not in acquisition. It would be interesting to evaluate possible differences in the acquisition rate of this behavior in other procedures.

Table 1
Mean (SD) of sociability measures. Pairwise comparisons between high and low sociability groups.

	Contact latency	TC passive	TC active	PC passive	PC active
High sociability	3.72 (5.37)	64.27 (28.2)	116.73 (4.57)	30.8 (18.19)	116.33 (4.39)
Low sociability	39.77 (15.6)	17.77 (29.46)	74.45 (46.51)	0.02 (0.06)	64.78 (50.24)
Z	−3.42	−3.51	−2.29	−3.74	−2.4
p	<.001	<.001	.024	<.001	.014

Note: TC = time close to experimenter; PC = physical contact.

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Since the duration of physical contact with the stranger was correlated with gaze duration in extinction, this sociability variable was used as criterion for dividing dogs into two extreme sociability groups. Interestingly, these groups in turn differed in all the remaining sociability measures: high sociability dogs approached faster and maintained a higher level of physical contact and proximity to the unknown human, while the Low sociability dogs had higher contact latency, and remained in contact with or near the experimenter for less time. These data is consistent with the idea that sociability would be a continuum that goes from lack of interest in the stranger to the active search of contact with her (Svartberg, 2003).

In addition, we found several associations between the variables of the sociability test and the temperament dimensions evaluated by a validated questionnaire. Specifically, stranger-directed fear was positively associated with the latency to contact the person and negatively associated with the time spent close to her. Thus, those animals that in their daily lives react with fear toward an unfamiliar person who seeks contact, also avoid spontaneous contact with an unknown experimenter. This correlation with a theoretically related and previously validated construct suggests that our behavioral test also measures sociability.

Moreover, the lack of associations between sociability measures and the questionnaire variables for non-social fear and attachment would indicate discriminant validity. Besides, the lack of significant correlations between sociability and non-social fear would indicate that fear tendencies toward strangers and toward non-social stimuli are independent. Furthermore, attachment questions may relate to social behaviors directed to the owner, whereas the sociability test might be assessing social tendencies only toward strangers. In support of this idea, other studies indicate that dogs interact differently with their owner than with a stranger. For instance, in an attachment test, greeting responses to the owner were more intense than to the stranger, and dogs remained less time in physical contact with the latter (Topál et al., 1998; Palmer and Custance, 2008; Valsecchi et al., 2010).

Altogether, these results suggest that the sociability test would have construct and discriminant validity. However, this conclusion needs to be taken with caution because just a few individuals were evaluated with both instruments (questionnaire and sociability test). Additionally, studies measuring test–retest reliability of the sociability test would be positive.

Despite these limitations, the sociability test has great potential for systematic evaluation of important aspects of dogs' temperament and social behaviors. Its application is simple and fast (only 4 min) and it is also easy to score, not requiring trained observers. In turn, at the applied level, the test could be a useful tool in dog shelters where the behavioral profile of numerous animals for subsequent adoption is needed.

Finally, the associations found between dogs' trainability and sociability measures are interesting from an applied point of view, because they suggest that more sociable animals would be more trainable. Trainability is characterized by the willingness to listen to the owner, obey simple commands, and ignore distracting stimuli (Serpell and Hsu, 2005). Thus, both this trait and sociability have in common a special attention to the human. According to our results, more sociable dogs would be more attentive to the human, so they could learn human signals more easily than less sociable dogs. In this sense, Braem and Mills (2010) reported that gazing toward the human, due to its relationship with attention, is a key factor in obedience training. Those animals that gaze longer at the guide learn new commands faster. Other evidence also suggests that attention is a key factor for dogs' good performance in human-guided tasks (Pongrácz et al., 2004; Range et al., 2009). It follows that those animals that sustain their gaze without receiving an immediate food reward might be more suitable for training and could have a better performance in complex tasks involving long behavioral sequences without reinforcement.

To finish, we conclude that sociability modulates gazing behavior toward human faces in dogs. More sociable animals gaze longer to obtain food out of their reach than less sociable ones. This suggests that it may be important to take into account the sociability level of a dog when selecting animals for different tasks as rescue, drug detection or participation in sports competitions. This is so because more sociable dogs pay more attention to humans, and thus may respond more effectively to their commands during training and actual performance.

Acknowledgments

This research was supported by CONICET and AGENCIA (PICT 2005, number 38020). We would like to express our special gratitude to Lic. Lucas Cuenya for his valuable comments of a preliminary version of the manuscript. Furthermore, we would like to thank Julián Ferreiro, Dr. Angel M. Elgier, Dr. Gabriela Barrera, Dr. Esteban Freidin, Canine School GB and its director Gustavo Bianco for their important collaboration in data collection and to Dr. James A. Serpell for putting the C-Barq at our disposal. We are really grateful to all the dog owners who participated in this study. Correspondence and request for reprints may be sent to the first author, Adriana Jakovcevic, at: Combatientes de Malvinas 3150, Ciudad Autónoma de Buenos Aires (1427), adrianajak@gmail.com

Appendix A.

Low sociability group: mean age: 4.42 years, range 1–9 years; sex: 6 male, 3 female; breed: 1 beagle, 1 German shepherd, 1 golden retriever, 2 labrador retriever, 2 poodle, 2 mixed breed. High sociability group: mean age: 3.33, range: 1–8 years; sex: 5 male, 4 female; breed: 1 brittany, 1 German shepherd, 4 golden retriever, 3 poodle.

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