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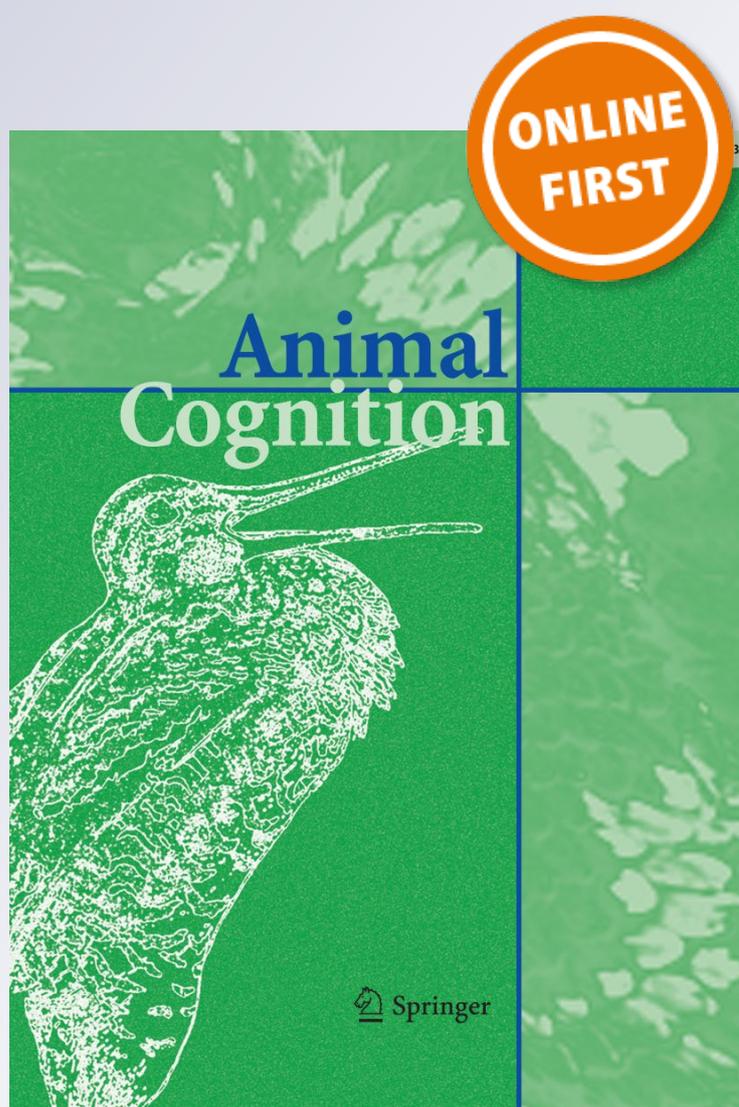
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Gazing as a help requesting behavior: a comparison of dogs participating in animal-assisted interventions and pet dogs

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Abstract

Dogs tend to gaze at humans when they are confronted with inaccessible food during an unsolvable task, which is often interpreted as a help requesting behavior. Dogs who participate in animal-assisted interventions (AAI) interact with many people during their lives and prior studies have emphasized the importance of gazing in their communication. We compared the behavior of AAI ($n = 15$) and pet ($n = 16$) dogs during an unsolvable task, using a container fixed to a wooden board with inaccessible food inside, while the owner and an unfamiliar woman stood facing each other at the sides of the board ignoring the dog. Results showed that AAI dogs spent significantly more time gazing and alternated their gaze more frequently between the container and the people than pet dogs. In addition, they spent more time in contact with the unfamiliar person. However, no significant differences were found in the time dogs of either group gazed towards the owner compared to the unfamiliar person, in the frequency of gaze alternation or in the time spent interacting with the apparatus. In line with prior studies, these results suggest that gazing may be a significant communicative response in AAI dogs, which could probably contribute to having a better coordination with their handler. A greater understanding of the characteristics of this population may aid the selection and training of AAI dogs, which is particularly relevant given the increased popularity of AAI nowadays.

Keywords Gazing · Unsolvable task · Domestic dogs · Animal-assisted interventions

Introduction

Domestic dogs (*Canis familiaris*) have remarkable abilities to communicate with humans. They respond to human communicative signals such as pointing, as well as produce their own signals to communicate with people and influence their behavior (e.g., Gácsi et al. 2004; Hare and Tomasello 2005; Topál et al. 2009). One of such communicative behaviors is gazing to the human face: dogs are able to use both direct

gaze and gaze alternation between an object and an observer to attract a person's attention and direct it towards a target of their interest (e.g., Miklósi et al. 2000). In species without hands, gaze alternation has been considered to have similar referential functions as pointing in humans (Leavens and Hopkins 1998), given that it attracts an observers' attention towards a distant object (Leavens et al. 2004).

The so-called unsolvable task has been extensively used to study gazing behavior in the field of dogs' social cognition (Cavalli et al. 2019a). In this situation, dogs are confronted with an apparatus containing food which is first accessible to them for a number of trials, and then the task becomes unsolvable because the food is not available anymore. When this happens, dogs tend to gaze towards people and alternate their gaze between the apparatus and the human face. It has been proposed that this communicative behavior was selected during dogs' domestication (Miklósi et al. 2003) and it is frequently interpreted as a request for help (e.g., Marshal-Pescini et al. 2017; Alterisio et al. 2018). Moreover, both an owner and an unfamiliar person are often present during the task, allowing the assessment of gazing behavior towards each of them (e.g., D'Aniello

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et al. 2015; Marshall-Pescini et al. 2009). However, dogs may gaze at people for other reasons, such as caution or vigilance because they are fearful of someone unfamiliar (e.g., Brubaker et al. 2017). This must be taken into account when analyzing the results, as not all gazes may be referential in nature (Smith and Litchfield 2013). The time the dogs spend gazing towards people is negatively correlated with their efforts to solve the task. This interaction with the apparatus is considered a measure of persistence, which is operationally defined as continuing attempts to open the container even when they are unsuccessful (e.g., Chow et al. 2016; Marshall-Pescini et al. 2017).

To uncover the relative influence of phylogenetic and ontogenetic factors in dogs' social cognition, the unsolvable task has been utilized with a wide variety of canid populations (Miklósi and Kubinyi 2016). Therefore, factors such as living conditions, training, age, and breed, have been investigated as factors determining the outcomes on this task.

To assess the effects of living conditions, some authors have focused on the behavior of dogs who do not live as pets. Among other differences, these dogs have a lower level of daily human contact during their lives. For instance, D'Aniello and Scandurra (2016) observed that dogs living in kennels gazed less and with a higher latency than pet dogs during this task. In line with this, Scandurra et al. (2015) found out that guide dogs living in kennels (i.e., trained guide dogs who had not yet been assigned to a family) gazed less than dogs living in families, regardless of having received training as guide dogs or not.

Other authors addressed how training for different kinds of tasks affected dogs' behavior during this test. Marshall-Pescini et al. (2009) reported that dogs trained for agility gazed more at people than search and rescue and pet dogs. Moreover, search and rescue dogs displayed more gaze alternation between the people and the apparatus in comparison with the other groups. Similar results were obtained by D'Aniello et al. (2015) in water rescue dogs, who spent more time gazing at people than untrained pet dogs. However, Gaunet (2008) found no differences between the gazing behavior of guide dogs and pets. In sum, the kinds of tasks they are trained to perform seem to modulate gazing behavior during this task.

Both a familiar (i.e., owner or handler) and an unfamiliar (i.e., experimenter) person are present during the task (Cavalli et al. 2019a). This setup allows to study whether prior experiences and learning with each person moderate to whom they direct their gazing behavior. Yet, prior findings are heterogeneous on whether they gaze more at the owner or they gaze towards both people equally. For instance, in Marshall-Pescini et al. (2009), agility dogs gazed more at the owner, while search and rescue dogs gazed equally to the owner and the unfamiliar person. The authors concluded that these results are in line with the

training the dogs received, as agility dogs must focus on their handler, while search and rescue dogs are encouraged to alternate their attention between the handler and the person they are looking for. In addition, D'Aniello et al. (2015) found that water rescue dogs directed their first gaze to the owner rather than the unfamiliar person. However, no differences were found between these dogs and pets in the total gazing time towards each person. Likewise, no such differences were observed in Scandurra et al. (2015) and D'Aniello and Scandurra (2016).

All in all, prior experiences such as the amount of contact with humans and the training received seem to modulate gazing behavior as it is observed during the unsolvable task. Nevertheless, it must be taken into account that sometimes it is hard to disentangle the effects of training and living conditions, as working dogs often live in different environments than pet dogs.

A population of particular interest regarding their gazing behavior is dogs participating in animal-assisted interventions (AAI), given that they usually have a higher amount of interaction with people than pet dogs. These interventions incorporate animals in areas such as health and education, with the aim of improving welfare and obtaining therapeutic gains (IAHAIO 2018). Although these dogs usually have some degree of training, its specific characteristics depend on the tasks they usually perform. These range from complex actions such as a tricks and agility-like circuits to more passive interactions like being petted or brushed. Mongillo et al. (2017) found that AAI dogs gazed more frequently at their owners and sustained their attention more on them than pet dogs on a visual attention test. Increased levels of attention in AAI dogs towards their owners could be due to them depending on their handlers for support when confronted with unpredictable situations such as those that may occur during AAI sessions. In line with this, Wanser and Udell (2019) state that dogs participating in AAA (animal-assisted activities, one kind of AAI) may use gazing to establish contact with their handlers and look for information to guide their behavior with a client or other stimuli present during their work. Furthermore, prior results from our laboratory (Cavalli et al. 2018, 2019b) indicate that AAI dogs maintained their gazing behavior to ask for food for a longer time than pet dogs, even during an extinction phase in which this behavior was not reinforced anymore. A possible explanation for these results is that AAI dogs often need to persist in their communicative intents as clients do not always respond properly to their cues. Regarding their living conditions, it must be remarked that AAI dogs live within a family as pets during their daily lives. However, they are in contact with several people during AAI sessions. This is of particular relevance, as living conditions and training experience are factors that are often confounded when assessing working dog populations.

Taking these findings into account, the aim of this study is to compare the behavior of dogs participating in AAI and pet dogs during an unsolvable task. It would be expected for AAI dogs to gaze and alternate their gaze more at people than pet dogs. There are no clear predictions regarding to whom they may gaze more. On the one hand, they may gaze more towards their owners in search of reference and contact during this situation, as it may occur during an AAI session. On the other hand, they may gaze equally to both the owner and the stranger, given that they are used to interacting with unfamiliar people during their work and often communicate with them by gazing.

Knowing more about the characteristics of dogs participating in AAI allows for a deeper understanding of how living conditions, training and the interaction with people modulate dog behavior. Moreover, determining key factors that differentiate these dogs from regular pets may aid their selection and training.

Method

Subjects

We evaluated 35 domestic dogs, but data from four dogs were omitted due to three being disinterested in the task (i.e., they did not reach the solvable phase criterion, see “[Procedure](#)”) and one because of camera error. Therefore, the final sample consisted of 31 adult dogs between 1 and 9 years old.

The AAI group ($N=15$, ten females, five males, mean age = 4, $SD \pm 2.3$, six mixed breeds, six golden retrievers, two labrador retrievers, one collie) consisted of dogs working in rehabilitation centers for kids and adults with mental and motor disabilities, hospital psychiatry units, private practice psychotherapy, educational programs and recreational visits. The interventions were at least weekly and, in all cases, involved the interaction with unfamiliar people. All dogs had been participating in AAI for a minimum of 1 year. Dogs from this group were recruited through direct invitation to AAI groups in the city of Buenos Aires.

The pet dogs' group ($N=16$, ten females, six males, mean age = 3.25, $SD \pm 2.2$; six mixed breeds, eight golden retrievers, one labrador retriever, one collie) consisted of dogs living in family homes who did not participate in AAI. These dogs were selected to match the characteristics (i.e., age, sex, breed) of the AAI sample. Dogs from this group were recruited through personal contacts and announcements in social media.

All dogs have lived with the family for at least a year. In two cases, the same household had both a dog participating in AAI and one not doing so. We asked the owners not to feed them in the 3 h prior to our visit, to increase their food motivation. Water was available ad libitum.

Materials

Dogs were evaluated in a quiet room within their homes. During the test, there were one owner and two experimenters, one who acted as the unfamiliar person (i.e., “stranger”) during the task and the other who refilled the apparatus between trials. The reinforcers were small pieces of cooked liver (cubes of approximately 1 cm^3).

We used a transparent container ($15 \times 15 \text{ cm}$) which had a lid that could be locked for the unsolvable trial. This container was fixed to a wooden board ($61 \times 29 \text{ cm}$) to avoid it from slipping around. At the beginning of each trial, the dog was held on a leash by one experimenter while the other put the food inside the container. During the unsolvable phase, the dog was freed and the people (owner and unfamiliar experimenter) stood each on one of the sides of the board (see Fig. 1), while the experimenter who refilled the apparatus was outside the room.

The task was filmed with two SONY DCR-SR88 cameras placed on tripods on opposite sides of the room, in order to capture the situation from different angles.

Procedure

Dogs had 3 min of habituation while we explained the procedure to the owners. The task started immediately afterwards and comprised two phases:

Solvable phase This phase lasted three consecutive trials. One experimenter put one piece of liver in the container and left it unlocked, so dogs could reach the food manipulating it with their paws or muzzle. During this phase, the owner was standing with their back turned to avoid any unintentional cuing. Each trial had a maximum duration of 1 min or until



Fig. 1 Experimental setup

the dog ate the food. We established a performance criterion in which only those dogs who got the food in two out of the three trials were able to continue onto the unsolvable task. The second phase started promptly after.

Unsolvable task This phase comprised only one trial. This time, the experimenter put three pieces of liver in the container and locked it, so dogs could not reach it anymore. Afterwards, she left the room while the other experimenter and the owner moved to their places on each side of the board. The side each person (owner/stranger) stood at was counterbalanced across subjects. People stood quietly with their hands behind their back and avoided eye contact with the dogs by gazing straight ahead during the duration of this trial. This phase lasted 3 min and dogs were free to interact with the people or the apparatus.

Data analysis

The 3 min of the unsolvable task were divided into six 30-s blocks and analyzed frame by frame at a rate of two frames per second (0.5 s). During this phase, we coded gazing time, latency of first gaze, direction of first gaze, frequency of gaze alternation, contact with the people and interaction with the apparatus (see Table 1 for a complete description of these behaviors).

We examined whether there were group (AAI/pet dogs) differences during the task. As most of the variables did not follow a normal distribution (Shapiro–Wilk, $ps < .05$), we used Mann–Whitney U test for this analysis. To examine if the dogs’ behavior varied across the task, we carried out a regression analysis with block as predictor and the sum of each behavior (gaze, gaze alternation, contact and interaction) as dependents. These new scores were normally distributed (Shapiro–Wilk, $p > .05$), and no heteroscedasticity was observed by graphic analysis of the data. In addition, we used Wilcoxon test to compare differential effects of gazing, gaze alternation and contact towards each person (owner/stranger). We used Fisher’s exact test to analyze if there were significant differences regarding to whom (owner/stranger) the dogs directed their first gaze.

A second observer, blind to the dogs’ group, coded 40% of the videos. Interobserver reliability was high for all variables (Rhos $> .94$, except “gaze alternation towards owner” = $.87$, $ps < .001$).

All tests were two tailed ($\alpha = .05$) and the data were analyzed with SPSS 20 and Prism 7.

Results

During the unsolvable phase, almost all dogs (all but one from the pet dogs’ group) gazed at least once towards one of the persons present in the test. Results are shown in Table 2. Dogs from the AAI group gazed significantly more than pet dogs ($U = 54.5$, $p = .010$, see Fig. 2). This difference was observed on gazing towards the owner ($U = 69$, $p = .043$), and there was a trend toward significance on gazing to the stranger ($U = 72$, $p = .057$). Moreover, AAI dogs alternated their gaze significantly

Table 2 Median and interquartile range of the measured behaviors

	Mdn (IQR)	
	AAI	PD
Gaze owner	10 (1.5–23.5)	1.5 (.5–10.37)
Gaze stranger	5 (2.5–7)	2.5 (.5–5.5)
Total gaze	26.5 (6.5–34)	3.25 (1.65–19.37)
Contact owner	.5 (0–1)	1 (0–2.37)
Contact stranger	1.5 (0–6)	.25 (0–3.87)
Total contact	1.5 (0–7)	3.25 (1–6.12)
Interaction	75.5 (52–95.5)	37 (21.75–88.25)
Latency	8.5 (5–32.5)	18.5 (5.25–60.62)
Gaze alternation owner	3 (1–6)	1 (0–2)
Gaze alternation stranger	2 (1–3)	1 (0–1)
Total gaze alternation	6 (2–9)	1.5 (1–3)

All values are expressed in seconds, except gaze alternation which was measured in frequency

O owner, *S* stranger, *AAI* dogs participating in animal assisted interventions, *PD* pet dogs

Table 1 Ethogram of the analyzed behaviors

Behavior	Definition
Gazing	Time (s) in which the dogs’ head was oriented towards the face of a person
Latency of first gaze	Time (s) elapsed from the start of the trial until the dog first gazed towards any of the people
First gaze	To whom (owner/stranger) the dogs directed their first gaze
Gaze alternation	Frequency in which the dogs’ head was oriented consecutively towards a person and the apparatus (or vice versa)
Contact	Time (s) in which any part of the dogs’ body was in contact with a person (including the muzzle if the dogs were sniffing)
Interaction with the apparatus	Behaviors aimed at obtaining the food such as gazing, grasping, scratching, nosing, biting and pushing towards the apparatus

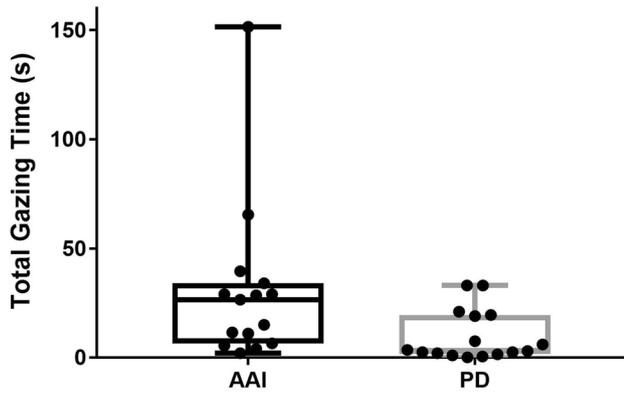


Fig. 2 Median and range of total gazing time towards people (owner and stranger). Dots represent individual values. *AAI* dogs participating in animal assisted interventions, *PD* pet dogs

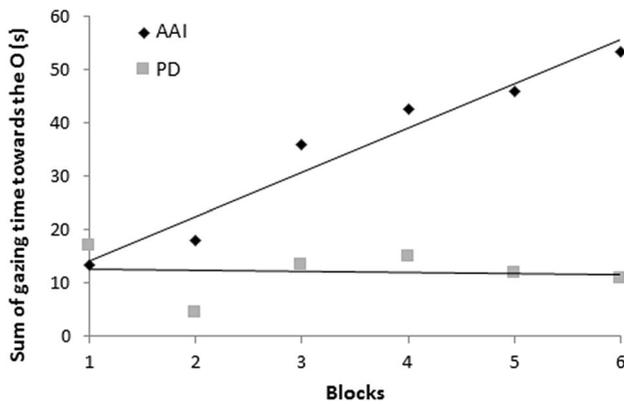


Fig. 3 Sum of gazing (s) towards the owner across blocks of the test. *AAI* dogs participating in animal assisted interventions, *PD* pet dogs

more than pet dogs ($U=45, p=.002$). This was observed for the alternation between the apparatus and the owner ($U=63, p=.021$) as well as the apparatus and the stranger ($U=48.5, p=.003$). However, we found no significant differences in latency to first gaze, contact with the owner,

contact with the stranger and interaction with the apparatus ($ps > .06$).

Concerning the behavior of the dogs throughout the test, we observed that gazing towards the owner increased significantly across blocks in the *AAI* group [$F(1,4)=72.91, p<.001, R^2=.94$], but not in the pet dogs one [$F(1,4)=.022, p=.88, R^2=.006$], see Fig. 3 and Table 3. This increase was not observed in gazing towards the stranger in either group ($ps > .37$). Moreover, interaction with the apparatus decreased significantly across blocks in both groups [*AAI*: ($F(1,4)=142.29, p<.001, R^2=.97$; pet dogs: ($F(1,4)=37.83, p=.004, R^2=.90$)]. No significant differences were observed in the time spent in contact with people ($ps > .36$).

Regarding the behavior towards each person, *AAI* dogs spent significantly more time in contact with the stranger than the owner ($Z=-2.43, p=.015$). No significant differences were observed in gazing and gaze alternation towards each of them ($ps > .130$). Furthermore, there were no significant differences in the proportion of dogs who directed their first gaze towards the owner compared to the stranger (*AAI*: owner = 7, stranger = 8; pet dogs: owner = 9, stranger = 6, Fisher's exact test = .715).

Discussion

The aim of this study was to compare the behavior of *AAI* and pet dogs during an unsolvable task where food was inaccessible. We focused on gazing towards the human face, as it is a communicative behavior which is frequently considered as a request for help in this context (e.g., Marshal-Pescini et al. 2017; Alterisio et al. 2018).

Although almost all dogs gazed at least once towards a person during the test, the results are in line with the prediction that *AAI* dogs would gaze and alternate their gaze significantly more than pet dogs. These findings highlight the importance of gazing for this dog population. They not only gazed more than pet dogs but also alternated their

Table 3 Sum of behaviors per block

	B1		B2		B3		B4		B5		B6	
	AAI	PD	AAI	PD	AAI	PD	AAI	PD	AAI	PD	AAI	PD
Gaze O	13.5	17	18	4.5	36	13.5	42.5	15	46	12	53.5	11
Gaze S	32.5	5.5	30.5	22.5	51	5.5	56	20.5	56	23	35.5	5.5
Contact O	1.5	3.5	2.5	3	5	6.5	.5	2	2	7.5	1.5	5
Contact S	2	8	6	6.5	12.5	14	11.5	3	19.5	7	5	9.5
Alt O	10	7	9	0	11	5	11	4	8	0	4	1
Alt S	12	3	7	1	7	1	1	3	3	3	0	1
Interaction	303	296	266.5	207.5	193.5	134	140	146	103	91	82.5	62

All values are expressed in seconds, except gaze alternation which was measured in frequency
O owner, *S* stranger, *AAI* dogs participating in animal assisted interventions, *PD* pet dogs

gaze more, which has been considered as a better measure to assess communicative behavior (e.g., Marshall-Pescini et al. 2017).

There are two possible, non-mutually exclusive, explanations for this behavior. One refers to the phenomenon of social referencing (i.e., seeking information from another individual in order to guide their behavior). For instance, dogs gaze at their owners when confronted with an ambiguous object (Merola et al. 2012) or an approaching unfamiliar person (Duranton et al. 2016). Therefore, dogs may use gazing during AAI sessions as a way to request information about the situation and how they should interact with the clients and other stimuli (Wanser and Udell 2019). Moreover, dogs may direct their attention towards their handlers as a source of emotional support as the sessions may be challenging and unpredictable (Mongillo et al. 2017). This use of gazing behavior may have been negatively reinforced by the handlers, as they may have noticed the dog was uncomfortable with a particular situation and redirected the clients to do something else or removed the dogs by ending the session early.

The other explanation focuses on the experiences dogs have during their ontogeny, as AAI dogs interact with a great variety and quantity of people during their lives. Furthermore, these people sometimes face health or developmental challenges and may not respond properly to their communicative attempts. These experiences may lead to an increase in some communicative abilities such as gazing (Cavalli et al. 2018). Nevertheless, this interpretation should be directly tested, given the heterogeneity of AAI sessions and the lack of scientific data regarding dogs' performance during them.

We also analyzed whether the dogs' behavior was directed differently towards the owner and an unfamiliar person. However, we found no significant differences in gazing, gaze alternation or the proportion of dogs who directed their first gaze to any of them. Prior literature on this topic is unclear, as some authors found that dogs gazed more at their owner during this task in some dog populations while others did not (e.g., such differences were found by Marshall-Pescini et al. 2009 and D'Aniello et al. 2015; but not by Scandurra et al. 2015 and D'Aniello and Scandurra 2016). Those results suggest that differential gazing towards a handler or a stranger may depend on the type of activity the dogs perform. Dogs participating in AAI are used to interacting with unfamiliar people in their work and they need to pay attention both to the handler and the client during visits. Regarding pet dogs, Kerepesi et al. (2015) suggested that these dogs are usually socialized to friendly strangers during their lives, so they may feel comfortable interacting with them during tests, particularly when the owner is also present. These statements support our findings, as dogs from both groups directed their gazing behavior to each person indistinctively. However,

there may be other motivations behind gazing behavior, in particular towards an unfamiliar person. For instance, we cannot exclude the possibility that some gazes towards the unfamiliar person might have been due to vigilance.

Moreover, AAI dogs spent more time in contact with the stranger than the owner during the task. Similar results were observed by Wanser and Udell (2019) during a mock AAA session. These authors suggested that, as AAI dogs are often encouraged to interact with clients, stay close and accept petting, it would be expected for them to spend more time in proximity to an unfamiliar person. However, our test situation differs from an AAI session in many aspects such as the duration and the scenario, so further research is needed to assess this possibility.

On the other hand, we found no differences in the time AAI and pet dogs spent interacting with the apparatus (i.e., scratching, biting, gazing, pushing, etc. to get access to the food). This is similar to what has been observed in other unsolvable task studies (e.g., D'Aniello et al. 2015; D'Aniello and Scandurra 2016; Marshall-Pescini et al. 2009), which suggest that the greatest difference between AAI and pet dogs may occur in social behavior.

Regarding how dogs behaved throughout the test, we observed a decrease in behaviors directed to solving the problem by themselves. This is in line with a process of behavioral extinction, as their attempts were not successful (Domjan 2014). Conversely, gazing towards the owner increased significantly in the AAI group but not in the pet dogs one. Therefore, it appears that these dogs persisted more in this communicative response. As it was mentioned previously, it is highly pertinent for AAI dogs to maintain their communicative intents when a client is not responding to them (Cavalli et al. 2018).

One limitation of this study that must be taken into account is the heterogeneity of the tasks carried out by dogs in the AAI group, which could lead to variations in their sociocognitive abilities. Furthermore, it must be considered that working dogs may have been selected for this type of work due to certain pre-existing characteristics, which may have affected their performance during this task regardless of their work experience (e.g., Bray et al. 2017).

In conclusion, AAI dogs gazed more towards people than pets during an unsolvable task. The results of this study suggest the importance of life experiences in dogs' gazing behavior. The nature of AAI work as well as a higher exposure to people may be associated with an increase in gazing and the persistence of this behavior when it is unsuccessful. The study of characteristics of AAI dogs is of particular interest given their recent popularity, due to the beneficial effects attributed to human animal interactions (e.g., Beetz 2017; Serpell et al. 2017) and their high social acceptability (Rabbitt et al. 2014).

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical considerations All applicable international, national, and/or institutional guidelines for the care and use of animals were followed. This study complies with the current Argentinean law of animal protection (Law 14.346) and all procedures were in accordance with the ethical standards and the approval of the CICUAL (Institutional Commission for the Care and Use of Laboratory Animals) from the Medical Research Institute IDIM CONICET (Res. Nro 101-18). All owners expressed their consent for the participation of their dogs in this study.

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