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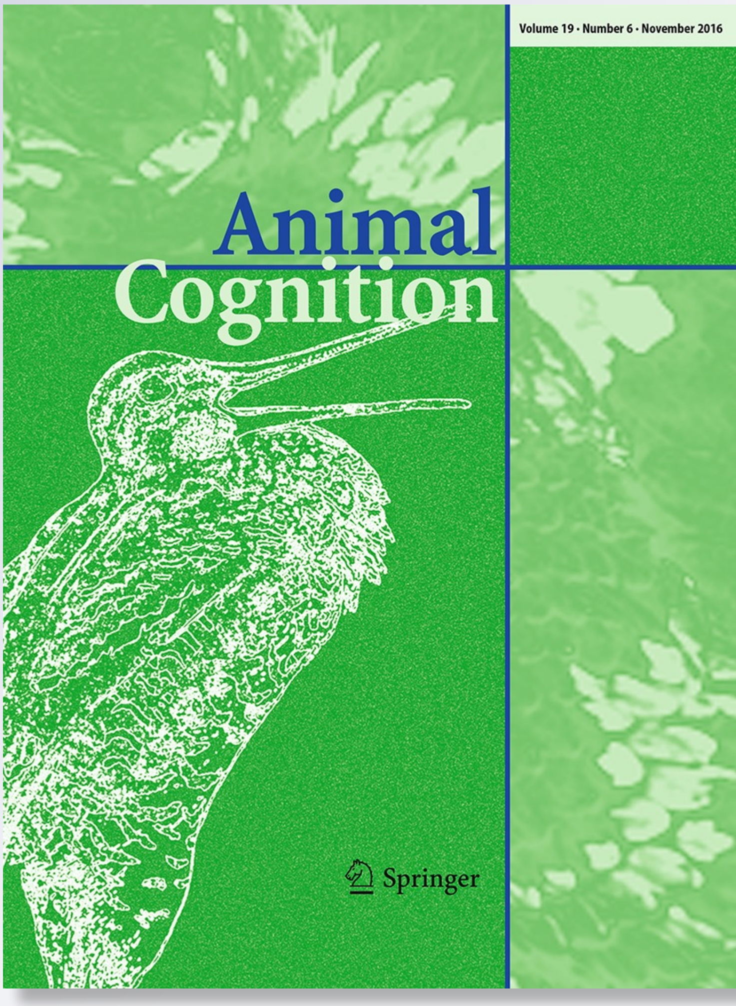

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ORIGINAL PAPER

Is previous experience important for inhibitory control? A comparison between shelter and pet dogs in A-not-B and cylinder tasks

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Abstract This study compares the performance of two groups of dogs with different levels of social interaction with humans, shelter and pet dogs, in two inhibitory control tasks. (1) In the A-not-B task, dogs were required to resist searching for food in a previously rewarded location, and (2) in the cylinder task, dogs were required to resist approaching visible food directly in favor of a detour reaching response. Our first aim was to evaluate the importance of learning and ontogeny in performing inhibitory tasks. Also, we assessed whether there is a correlation between the two tasks by comparing performance in the same subjects. Results showed significant differences between shelter and pet dogs in the A-not-B task, with poorer performance in shelter dogs. However, no differences were found in the cylinder task. The poorer performance of shelter dogs might be related to their infrequent interaction with humans, which reduces the chances to learn to inhibit certain behaviors. This result would highlight the importance of ontogeny in developing that ability. On the other hand, no correlations were found between the two tasks, which contributes information to the debate about the context specificity of inhibitory control in dogs.

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Introduction

"Inhibitory control" is a complex construct that can be broadly defined as the ability to resist the urge to do something that is immediately tempting, but ultimately harmful or counterproductive (Bray et al. 2014). It represents a collection of cognitive processes that are grouped together by virtue of a common function (Roberts et al. 2011): to facilitate a more adequate behavior by preventing a more impulsive or prepotent response (Marshall-Pescini et al. 2015). Animals have evolved inhibitory control that allows for adaptive responses in a variety of contexts such as reproductive success, foraging efficiency, and social systems (MacLean et al. 2014). Consequently, it is generally accepted that inhibitory control is essential for effective interaction with the environment (Burke et al. 1991).

Pet dogs have adapted to live in human society through a complex domestication evolutionary process (e.g., Hare and Tomasello 2005). Furthermore, they live in close contact with humans and depend on them throughout their life; hence, they have numerous opportunities to learn to predict people's behavior and respond accordingly (for a review, see Udell and Wynne 2010). In many cases, these interactions require inhibitory control from the dog. Quite often in everyday life, they wait for food or a reward; sometimes, they reject certain types of food if they predict that something better can be obtained by waiting. They are also capable of resisting the impulse of performing behaviors that are unwanted by their owners. The requirement for this inhibitory control is even greater in those groups of dogs that are involved in complex training to provide community services like assisting humans with disabilities, hunting, searching, and rescuing. Inhibitory control could thus be a major tool for achieving favorable adaptation and a beneficial interspecific relationship affecting behaviors like aggression, obedience, training, and other relevant aspects (Wright et al. 2011).

In order to evaluate inhibitory control in dogs, a series of tasks have been conducted, including reversal-learning tasks (e.g., Tapp et al. 2003; Wobber and Hare 2009), the A-not-B task (e.g., Topál et al. 2009), and the cylinder task (e.g., Marshall-Pescini et al. 2015), to name a few.

On the one hand, it has been suggested that the capacity needed to solve some types of tasks like the cylinder task (e.g., Marshall-Pescini et al. 2015) and the A-not-B task (e.g., Sümegi et al. 2013; Topál et al. 2009) is mainly affected by domestication. Also, there is evidence in different species suggesting that inhibitory control is strongly affected by training and experience (e.g., Glady et al. 2012; Oaten and Cheng 2006). Research on dogs has shown differences between groups with different levels of socialization and/or training in a wide range of tasks like issuing communicative cues (Barrera et al. 2012) and solving other social and cognitive problems (Marshall-Pescini et al. 2009).

Evaluating dog populations with different levels of daily interaction with humans is one of the most significant approaches to help shed light on the debate about the relative weight of ontogeny and domestication (Barrera et al. 2008; Udell et al. 2010a). There is evidence that shelter dogs show poorer performance than pet dogs in a variety of communicative and problem-solving tasks (e.g., Barrera et al. 2015; Udell et al. 2008), although they are capable of improving these abilities with additional training (e.g., Udell et al. 2010b; Wynne et al. 2008). However, no differences seem to be observed in other tasks like training ability, aggression, and gaze acquisition (e.g., Barrera et al. 2011, 2013). For example in the impossible task paradigm, kennel dogs (D'Aniello and Scandurra 2016) as well as guide dogs during their kennel time (Scandurra et al. 2015), while persisting on the apparatus in trying to solve the given task, gaze toward people with higher latency than pet dogs. Considering that the task is unsolvable, the persistence in the response could be due to a lower level of inhibitory control in shelter dogs. In that situation, animals should look for some alternatives like gazing at people for some help, requiring certain inhibition toward the apparatus containing food. Nevertheless, in a different experimental setting in which the food was not reachable, shelter dogs gazed at human with the same latency as pet dogs (Barrera et al. 2012), indicating that different experimental conditions in the same experimental paradigm may give different results.

On the other hand, it has been suggested that inhibitory control is subject to interference from other task-specific demands, i.e. it is hypothesized that inhibitory control is context-dependent (e.g., Bray et al. 2015; MacLean et al. 2014). For example, Bray et al. (2014) measured intra-individual variability in dogs' inhibitory control depending upon context and found no correlation between the A-not-B task, the cylinder task, and a social-reputation inhibitory task. Likewise, Marshall-Pescini et al. (2015) used a cylinder task together with a detour task and found no correlation in performance across tasks in either of the species evaluated—dogs and wolves. Furthermore, they found that dogs performed better in the cylinder task, but that wolves outperformed dogs in the detour task. However, more studies are needed to reach solid conclusions about the potential contextual factors affecting performance (MacLean et al. 2014), since there is also evidence that some species show generalized inhibitory control abilities (e.g., Baumeister et al. 1998; Duckworth and Seligman 2005). As far as we know, except for Bray et al. (2014), there is no study that has managed to measure intra-individual variability in dogs through A-not-B tasks and cylinder tasks using the same subjects.

Taking this background into account, our first objective was to assess the importance of learning and previous experience in ontogeny during the performance of inhibitory tasks by comparing shelter and pet dogs. If ontogeny shapes inhibitory abilities, it might be assumed that the performance of pet dogs should be different from that of shelter dogs, given the differences in the level of social interaction in the two groups, without ruling out other deficiencies and limitations probably present in shelter environments. To this end, we evaluated these two groups of dogs in two widely used inhibitory control tasks: the A-not-B task and the cylinder task.

The second objective was to evaluate whether there is a correlation between the two tasks. With this goal in mind, we compared the performance of the same subjects in the A-not-B task and the cylinder task. These results would contribute information to the debate about the influence of context (Bray et al. 2014, 2015) by showing whether the capacity to inhibit impulsive behaviors depends on the subject's context or whether it is a general capacity, where subjects with greater inhibitory control would consistently perform better in inhibitory tasks in various contexts.

Method

Ethical statement

This protocol was approved by the Comisión Institucional para el Cuidado y Uso de Animales de Laboratorio (CICUAL-Institutional Animal Care and Use Committee) from the Instituto de Investigaciones Médicas (Medical Research Institute) (Res. N° 023-15). All owners and shelter caregivers expressed their consent for the participation of the subjects in this study. No dogs had to be constrained to participate.

Subjects

We evaluated 27 healthy mongrel adults dogs, aged 1–10 years, of both sexes. There were thirteen dogs living in a dog shelter, 8 males (61 %) and 5 females (39 %), and 14 living as pets in family houses, 5 males (36 %) and 9 females (64 %). All dogs had more than 1 year living in the respective home (shelter or family house), and none of them had any formal obedience or agility training or were familiar with test procedure or the experimenters. We excluded subjects whose owners or caregivers reported the presence of aggressive behavior and/or excessive fearfulness to strangers. Two shelter dogs did not participate in the A-not-B task because they were adopted. A female pet dog could not be assessed in the A-not-B task due to technical problems. Therefore, Samples were configured as follows: 11 shelter dogs versus 13 pet dogs completed the A-not-B task, and 13 shelter dogs versus 14 pet dogs completed the cylinder task.

Shelter dogs belonged to "Soplo de Vida" shelter in the Province of Buenos Aires. They lived in kennels 2 × 4 m grouped in pairs or alone, with olfactory, auditory and visual contact with the rest of the dogs in neighboring kennels. They had outdoor 15 × 30 m recreation parks composed of grass and dirt, where they were allowed to walk in small groups approximately 2 h a day. The daily feeding routine consisted of dry dog food. Contact with caregivers was during feeding, cleaning kennels, and when moved to recreation parks. A veterinarian checked sick dogs once a week. The previous history of shelter dogs was not considered in the study due to the lack of information about each animal.

Materials and experimental setting

We administered two inhibitory control tasks, which were conducted at the location where the dogs lived: in the case of pet dogs, in a room of the family house frequented and known by the dog; in the case of shelter dogs, in one of the typical shelter enclosures known by the dog. Both tasks were administered separately with a 2-month interval and applied in a counterbalanced order across dogs. In addition, in each task, the side (right–left) from which the reinforcement was retrieved was counterbalanced across subjects.

The owners or the shelter caretakers were not present during the procedure and were requested not to feed the dog for 6–8 h before the experiment so as to keep the animal highly motivated to perform the task. The dogs had free access to water throughout the experiment. An experimenter and a handler were present in the test room. The experimenters were always unknown to the animals. The reward used in the two tasks was cooked liver and, according to the procedure, the experimenter or the handler provided social reinforcement.

For the A-not-B task, we used three cups with a diameter of 8.5 cm and a height of 10 cm, made of expanded polystyrene on account of its light weight that prevented any distractions caused by noise during baiting. The subjects looked at three opaque aligned cups (A, M, and B), and a reward was placed in one of the cups located at the far end of the array, while the middle cup (M) and the cup at the other end remained empty. The cups were separated from each other by 1.20 m. The start line (where the dog and handler were waiting) was at 2.10 m from the middle cup. Liver was spread on all three cups to control for odor cues (Fig. 1).

For the cylinder task, a totally transparent acrylic tube was used (25 cm in length × 24 cm in diameter × 4 mm in thickness). It was open on both sides and attached to a wooden base for support. During training, the cylinder was opaque, being covered with thick black card. The experimenter wore a belt pouch with food and sat on the floor 40 cm behind the tube placed toward the dog, while the handler had the dog on a leash at the start line located at a distance of 1.50 cm from the cylinder (Fig. 2).

Sessions were all filmed with a Sony DCR SX-85 camera so as to subsequently measure behaviors and assess inter-observer reliability. An additional JVC GZ-MG335HU camera was used in case the other one failed.

Procedure

The protocols used were like those used in previous experiments of this type except for some modifications made to vary the difficulty level and prevent the ceiling effect evidenced in dogs in some studies that applied tasks of this kind (e.g., Bray et al. 2014; Marshall-Pescini et al. 2015).

A-not-B task

This task required the subjects to inhibit the prepotent motor response to search in a previously rewarded location after they witnessed the reward being moved from that location to another (Bray et al. 2014).

The procedure comprised three phases:

In the *pre-training*, the purpose was to allow dogs to learn that the cups were baited. The experimenter walked up to the food source located in the room behind the handler, held the reward in one hand and passed it near the dog's face so that the animal could see it and smell it. Then the experimenter approached cup A, showed the reward in

Fig. 1 A-not-B task experimental setting. **a** The experimenter baits the cup with cooked liver, at dog's sight. **b** The handler holds the dog on a leash so as it can freely choose between the three-lined cups, and the experimenter turns her back to the dog almost in the center of the array 1 m behind it

Fig. 2 Cylinder task experimental setting. **a** The experimenter baits the opaque cylinder during training. **b** The dog executes a slight detour reaching response to recover the reward (correct response) during training. **c** The dog executes a slight detour reaching response to recover the reward (correct response) during test. **d** The dog fails to execute the detour response to recover the reward (incorrect response) during test

his hand to the dog, bent down, placed the reward in cup A, and stood up. After standing still for 2 s, the experimenter turned his/her back to the dog and the handler (so as not to generate any cues when the dog had to make its choice) and stood almost in the center of the array 1 m behind it. Immediately, the handler dropped the leash to allow the dog to choose freely. Responses were considered correct if the dog touched the baited cup with its snout, in which case the handler lifted the cup to allow the dog to eat the reward and verbally reinforced the dog by saying "very good" ("muy bien" in Spanish). Responses were considered incorrect if the dog selected one of the two unbaited cups, in which case the handler said "no" and took the dog back to the start line. Also in this case, the experimenter removed the reward from the baited cup without the dog watching. Incorrect responses were also computed if after 30 s, the dog did not walk forward, so we moved to the next trial. This procedure was repeated for each of the three cups A, M, and B, until the dog managed to retrieve the reward correctly from each container as a first choice. Trials were continuous with no intervals. After 1 m, the next phase started.

The procedure of the *training* phase was identical to the pre-training, except that the experimenter always placed the reward in cup A. The subjects were required to retrieve the reward in more than five, not necessarily consecutive, trials out of a maximum of 10 opportunities. Intervals between trials were 20 s, and 20–40 s after completing this phase, the test trials started. Unlike previous studies where dogs completed three A trials, i.e. training trials toward the location of cup A (e.g., Bray et al. 2014; Topál et al. 2009), our method increased the number of training trials to five, thus being more demanding regarding subsequent inhibitory behavioral flexibility.

In the *test* phase, the procedure was similar to training, except that after the subjects had watched the experimenter baiting cup A, the experimenter removed the bait and, in full view of the subject, took it to the cup located at the other end of the array (cup B). Dogs were required to retrieve the reward for a total of 15 trials. A first choice of cup B was considered a correct response. Intervals between trials were 20 s. The location of cup A and B (right or left) was counterbalanced across dogs.

Cylinder task

In this task, dogs were required to inhibit approaching a desirable food reward directly, in favor of a slight detour response (Bray et al. 2014).

The procedure comprised two phases:

In the *training* phase, the purpose was to allow the subject to learn that the cylinder was baited. In this phase, the opaque version of the tube was used. The experimenter showed the reward to the dog, called the dog by its name and said "look," placed the reward inside the cylinder through one of the openings, said "look" again, removed his/her hand from the cylinder, and then said "OK." After the command, the handler dropped the leash to allow the dog to freely walk forward to the cylinder. The reward was always placed in the center of the tube, so that the animals could reach it from either side. The learning criterion was established as four consecutive correct trials, out of a maximum of 15 opportunities. Intervals between trials were of 20 s, and 1 min after completing this phase, the test started.

In the *test* phase, trials were identical to the training phase except that the opaque cylinder was replaced with a transparent tube. Dogs were required to retrieve the bait in a total of 10 trials. Intervals between trials were 20 s.

In both phases, responses were considered correct if the dog's snout entered any of the open ends of the cylinder without the dog first touching the exterior of the cylinder with any part of its head or paw, in which case the experimenter said "very good." Conversely, responses were coded as incorrect if the dog touched the front or back of the cylinder with its snout or paw prior to recovering the treat, in which case the experimenter said "no," the dog was not allowed to eat, and the handler took the subject back to the start line. If the dog did not move forward after being called for the second time, 15 s after the first call, this was coded as a non-choice response and counted as incorrect.

Measures

The same two measures were taken in both tasks, both in training and test trials.

1. Number of trials before the first correct response during training and test phases.
2. Frequency of errors (incorrect and no-choice responses) during training and test phases.

Data analysis

Sessions were scored live by one of the experimenters, and a second observer scored all variables from the video record from 20 % of the sample. The analysis of inter-observer reliability showed excellent correlations between the two observations ($r_s > .986$; $Ps < .0001$, $N = 6$).

The data distributions departed significantly from the normal (Shapiro-Wilk: $Ps < .02$), except for the frequency of errors in the test phase of the A-not-B task ($Ps > .13$); therefore, we used nonparametric tests for group comparisons, except for the frequency of errors in the A-not-B task in which the independent samples t test was applied.

The Mann–Whitney U test was used to compare the two groups in the remaining measures. For all correlations, we calculated Spearman rho correlation coefficient. In each task, the first and last block of five trials were pooled and compared using Wilcoxon test in order to evaluate possible learning effects.

Our statistical analysis did not revealed sex differences in either group in either test (Mann–Whitney U: all values $P > .05$; cylinder Sample: males $N_{shelter} = 8$, females $N_{shelter} = 5$, males $N_{pet} = 5$, females $N_{pet} = 9$; A-not-B Sample: males $N_{shelter} = 8$, females $N_{shelter} = 3$, males $N_{pet} = 5$, females $N_{pet} = 8$).

The analyses were performed with SPSS Statistics 17.0. All tests were two-tailed with an alpha of .05.

Results

A-not-B task

In training trials, we did not find significant differences between shelter dogs and pet dogs in either measure (trials required until giving the correct response: $U = 50.5$, $P = .945$, frequency of errors: $U = 65$, $P = .662$, $N_{shelter} = 11$, $N_{pet} = 13$).

In test trials, we found significant differences in the number of trials required until giving the correct response ($U = 34.5$, $P = .021$, $N_{shelter} = 11$, $N_{pet} = 13$). Shelter dogs required a greater number of trials than pet dogs, showing slower learning. Also, we found significant differences in the average frequency of errors ($t_{22} = 4.88$, $P = .0001$, $N_{shelter} = 11$, $N_{pet} = 13$). Pet dogs made a lower mean number of incorrect responses than shelter dogs, showing better performance (shelter dogs:

M ± SD = 9.09 ± 1.07; pet dogs: 3.23 ± 0.63; Fig. 3). Thus, pet dogs performed on average 78 % of correct responses while shelter dogs made an average of 39 % correct responses.

To evaluate the effect of learning during the test, we compared the frequency of errors of the first and last block of five trials collecting data from both groups. We found significant differences between these blocks of trials, with a greater number of errors in the first block (Wilcoxon test, $Z = -2.04$, $P = 0.041$; first block: 2.29 ± 1.76; second block: 1.42 ± 1.69*;* $N = 24$).

We found a positive correlation between the frequency of errors, and the number of trials required until giving the correct response, both in training ($r_s = .436$, $P = .033$; $N = 24$) and test ($r_s = .548$, $P = .006$; $N = 24$) trials.

Cylinder task

In training trials, we did not find significant differences between shelter dogs and pet dogs on either measure (trials required until giving the correct response: $U = 90$, $P = .959$, frequency of errors: $U = 74.5$, $P = .404$, $N_{shelter} = 13$, $N_{pet} = 14$).

In test trials, we did not find significant differences in the number of trials required until giving the correct response ($U = 90$, $P = .954$, $M \pm SD = 1.54 \pm 0.88$, $N_{shelter} = 13$, $M \pm SD = 1.43 \pm 0.65$, $N_{pet} = 14$). We did not find significant differences in the frequency of errors either ($U = 89.5$, $P = .940$, $N_{shelter} = 13$, $N_{pet} = 14$), pet dogs made a mean of 1.86 errors (*SD* ± 1.41; 81 % average of correct responses), while shelter dogs made a mean of 2.38 errors (*SD* ± 2.66; 76 % average of correct responses).

To evaluate the effect of learning during the test, we compared the frequency of errors of the first and last block of five trials, combining data from both groups. As in the A-not-B task, we found significant differences between these blocks of trials, with a greater number of errors in the first block ($Z = -2.85$, $P = .004$; first block: 1.33 ± 1.24; second block: 0.78 ± 1.01; $N = 27$).

As in the A-not-B task, we found a positive correlation between the frequency of errors and the number of trials required until giving the correct response, both in training ($r_s = .786$, $P < .001$; $N = 27$) and test ($r_s = .633$, $P < .001$; $N = 27$) trials.

Correlations between tasks

In a comparison between tasks pooling the performance of all subjects ($N = 24$), the results showed that the number of trials required until giving the correct response in the A-not-B task was not correlated with number of trials required until giving the correct response in the cylinder task ($r_s = -.013$, $P = .952$). Also, the frequency of errors in the A-not-B task was not correlated with the frequency of errors in the cylinder task ($r_s = .181$, $P = .397$). Furthermore, the correlations in each group separately did not yield significant values in number of trials required until giving the correct response ($r_s = -.134$, $P = .664$, $N_{pet} = 13$; $r_s = -.043$, $P = .899$, $N_{shelter} = 11$) or in the frequency of errors ($r_s = .408$, $P = .166$, $N_{pet} = 13$; $r_s = -.219$, $P = .518$, $N_{shelter} = 11$).

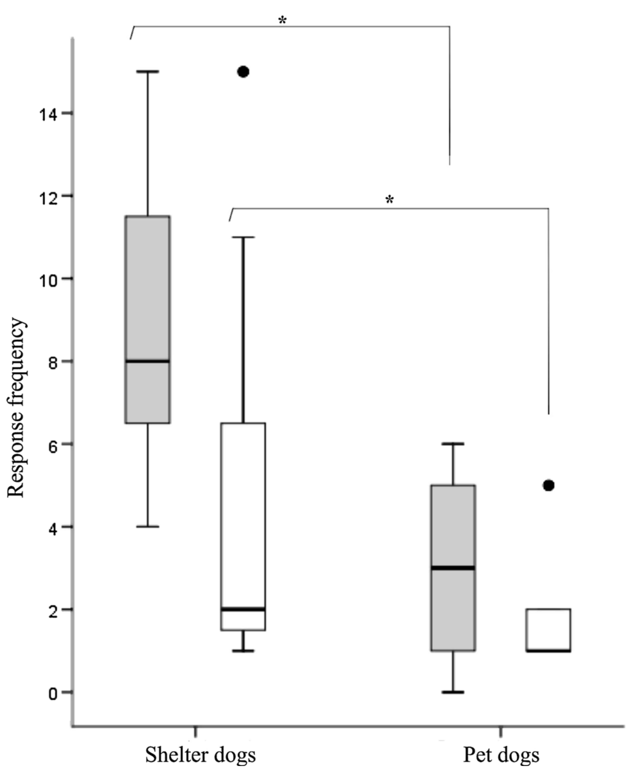

Fig. 3 Response frequency in the A-not-B task measures of shelter and pet dogs. *Gray boxes* represent the frequency of errors (incorrect and no-choice responses). *White boxes* represent frequency of trials required until selecting cup. **b** The *bars* represent the interquartile range containing 50 % of values, and the *lines* indicate the median. The *error bars* extend from the box for the maximum and minimum values. *$P < .05$, two-tailed tests

Discussion

Our main goal was to compare the performance of pet and shelter dogs in two inhibitory tasks so as to evaluate the possible effects of learning during ontogeny on those abilities. If ontogeny shapes inhibitory abilities, performance would be affected by limited social interaction with humans, without ruling out other deficiencies probably present in shelter environments, so that shelter dogs would very likely underperform their counterparts.

The results obtained in the A-not-B task support this prediction, as significant differences were noted in the test trial phase across both groups, which suggest that shelter dogs might have greater difficulty with inhibitory control than pet dogs. This difference cannot be attributed to similar learning problems because no differences were observed between pet and shelter dogs during training trials in either of the tasks. These results are in agreement with previous findings in the literature regarding other communication skills in dogs, such as social responses and problem solving (e.g., Barrera et al. 2011, 2012, 2013, 2015; D'Aniello and Scandurra 2016; Udell et al. 2008, 2010b; Wynne et al. 2008) that show poorer performance in shelter dogs vis-à-vis pet dogs.

Notwithstanding this, another possible explanation is that living conditions in shelters increase stress levels in dogs thus affecting their responses (e.g., Rayment et al. 2015; Tuber et al. 1999). This could be possible if we consider that stress levels affect executive functions in general, as seen in humans and in other animal species (e.g., Alexander et al. 2007; Arnsten and Goldman-Rakic 1998; Bannon et al. 2002).

In the cylinder task, no significant differences were noted between pet and shelter dogs in either of the measures taken in the test, which suggests that there are no differences across the groups in their ability to inhibit the tendency to approach the visible food or perform the detour reaching response required. The lack of differences could have several explanations. The most parsimonious explanation is that the task might have been too easy for the subjects, with 81 % of correct responses in pet dogs and 76 % in shelter dogs, which might prevent the observation of major differences across the groups. A similar argument is put forward by Marshall-Pescini et al. (2015) regarding the cylinder task and by Bray et al. (2014) who argue about a ceiling effect as a possible explanation for the lack of correlations between the inhibitory tasks applied.

Another important factor regarding subjects' performance in this task is the perceptual characteristics of the barrier, which may influence detour tasks (Zucca et al. 2005). Pet dogs may be more familiar with transparent barriers than shelter dogs and have previously learned to response to those barriers. However, if this was the case pet dogs should have performed better than shelter dogs and our results do not support this idea.

Finally, within-task comparisons both in the cylinder and the A-not-B tasks showed a positive correlation between the two measures recorded in the training and test trials. This implies that both measures on each test are consistent and highly related.

The second objective was to correlate the performance of each dog in the A-not-B task and the cylinder task. Our results did not yield significant correlations in any of the measures, which is in agreement with the evidence that shows a lack of correlation between inhibitory tasks in dogs (e.g., Bray et al. 2014; Marshall-Pescini et al. 2015). This could mean that the ability to inhibit impulsive behaviors depends on the subject's context. Yet, these results differ from other evidence suggesting that inhibitory control is a highly general skill (e.g., Duckworth and Seligman 2005).

However, it is debatable whether the lack of correlation between tasks actually reflects different inhibitory control mechanisms between contexts (e.g., a social vs. a physical context, a search versus a waiting context) or whether the same mechanism is involved within an individual, but other task demands (e.g., quantity discrimination, learning, type of reinforcement used) may influence performance (Bray et al. 2014).

Additionally, the difficulty levels of the tasks are seemingly different, which would affect the degree of variability in the subjects' performance in one or the other. The lack of correlations between the cylinder and the A-not-B tasks could be due to the fact that the cylinder task could have been too easy for the subjects. A similar situation could have arisen in the work by Bray et al. (2014) and Marshall-Pescini et al. (2015). In future studies, a reasonable goal would be to create variations in the design of the cylinder task so as to increase its difficulty, for example to increase the number of training trials with the opaque cylinder, as we did in the A-not-B task, or to use a longer tube requiring a more challenging detour reaching response.

Possibly, the skills needed for each task interact with skills for inhibitory control, yielding intra-individual differences between contexts (Bray et al. 2014). In any case, a possible way forward is a multitask approach to evaluate the inhibition construct (Marshall-Pescini et al. 2015); comparing social and non-social tasks could be a way to continue investigating context specificity in this skill.

In conclusion, there are differences in inhibitory control in these groups, with pet dogs exhibiting superior performance of this skill. From an applied perspective, considering that inhibitory control difficulties usually result in behavioral problems (e.g., Fatjó et al. 2005; Stahl et al. 2014; Wright et al. 2012), which in turn makes the reintegration of shelter dogs to new households difficult, our study underlines the importance of increasing the inhibitory control of shelter dogs before adoption. Likewise, the study of inhibitory control is relevant for areas where dogs are trained to perform various tasks like drug detection, rescue, and assistance to humans with disabilities.

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