Synchronous Citizen Science with Dogs

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Abstract

Citizen science approaches have grown in popularity over the years, partly due to their ability to reach a wider audience and produce more generalizable samples. In dogs, these studies, though, have been limited in their experimental controls. Over two studies, we explored and validated a synchronous citizen science approach. We had dog guardians act as experimenters while being supervised by a researcher over Zoom. In study 1, we demonstrated that synchronous citizen science is appropriate for trial-based research. We found, consistent with past work from in-lab research, that dogs are significantly better than chance at selecting a treat (vs. an empty plate) in a two-alternative forced-choice task. In study 2, we showed that Zoom studies are appropriate for looking-time studies. We explored dogs' looking behaviors when a bag of treats was placed in an unreachable location and dogs' guardians were either attentive or inattentive while dogs attempted to retrieve the treats. We found, consistent with past work, that dogs in the attentive condition looked at their owner for longer periods and had a shorter latency until the first look than dogs in the inattentive condition. Overall, we have demonstrated that synchronous citizen science studies with dogs are feasible and produce valid results consistent with those found in a typical lab setting.

Synchronous Citizen Science with Dogs

Citizen science, or engaging with members of the public to participate in the scientific process, has become increasingly popular. Citizen science can increase community engagement, and can allow for the collection of more naturalistic data from more generalizable populations, thanks to the lack of geographic restrictions in collecting data.

One species that is ideal for exploring citizen science more is dogs. Dogs have a unique social relationship with humans, living closely with us in or around our homes, but also serving in a variety of working roles. Dogs have an exceptional ability to respond to human social-communicative gestures, particularly when compared to wolves and our closest genetic relatives, the great apes (Bräuer et al., 2006; Hare et al., 2002). The ubiquity of dogs around the world provides a wealth of opportunities to explore learning in a non-human context (ManyDogs Project et al., 2023). In companion animals like dogs and cats, citizen science has some significant advantages, such as providing larger samples and more naturalistic data by collecting the data in the animal's daily environment (Smith et al., 2021, 2022; Stewart et al., 2015).

The majority of cognitive studies with pet dogs have been conducted in a laboratory context. Dog guardians bring their dogs into the lab, and after some acclimation period, dogs participate in studies that take the form of treat-finding games. In these games, dogs may solve a physical problem (like a puzzle box) or receive social information from a human informant (see Bensky et al., 2013 for a review). Dogs' behaviors in response to the problems they are presented with are recorded and analyzed. These behaviors range widely, including choices (where the task is typically a forced choice between a series of alternatives) and looking behaviors (where time spent looking at or away from target objects is recorded).

From this work, we know that dogs are skilled social learners and that they are sensitive to a variety of characteristics of human informants such as their accuracy (Pelgrim et al., 2021), and prosociality (Silver et al., 2020). Dogs are sensitive to human gaze patterns. For instance, dogs can take on the visual perspective of a person, using this ability to selectively trust someone who saw food being hidden vs. someone who didn't (Catala et al., 2017; Maginnity & Grace, 2014). Dogs are also able to use the human gaze as a cue for the person's attentional state. Dogs beg more from experimenters who are looking at or facing them than experimenters who were not (Bräuer, 2014; Gácsi et al., 2004). In addition, dogs are less likely to follow the commands of an experimenter that is facing away from them (Yamamoto et al., 2011). In-lab research has also explored canine cognition in a developmental context. From puppyhood, dogs are able to learn how to solve novel problems by observing conspecifics (other dogs) and humans (Bray et al., 2021; Fugazza et al., 2018). Dogs tend to prioritize independent problem solving, however, when faced with impossible tasks, dogs give up and look back to human partners, something that has been suggested as a kind of social problem solving strategy (Johnston et al., 2021; Miklósi et al., 2003; Passalacqua et al., 2011). When seeking help from human partners, dogs are selective in who they look back to. In an ability they share with human children, dogs preferentially look to attentive (vs. inattentive) people when a previously solvable task becomes unsolvable (Marshall-Pescini et al., 2013).

Overall, research in the lab has made significant advances in our understanding of canine cognition and learning as a whole. In recent years, however, in part due to the COVID-19 pandemic, researchers have begun exploring new methods for studying canine cognition in alternative contexts. Further, a large part of the motivation behind studying canine cognition is that unlike other animal species commonly explored in research, dogs typically live in homes with people. Introducing dogs to the lab environment can be stressful, and for dogs with anxiety or aggression, participating in lab-based cognitive studies is often not possible. Exploring dogs' cognitive abilities in an environment that they are comfortable in, may help to improve task performance, and increase the kinds of dogs that can participate.

Citizen science can reduce the time burden on the researcher, and provide a widely generalizable sample without the researcher needing to engage with each participant individually. In traditional citizen science with companion animals, researchers send details of the study to the animal's guardian. The guardian then conducts the experiment and may input the data of interest directly in response to form questions (Stewart et al., 2015), however, this limits the ability to check data accuracy as subsequent re-coding or verification is not possible. Because of this limitation, some citizen science projects have guardians submit video data of the experiment to be coded by a researcher (Smith et al., 2021, 2022). This has the advantage of providing strict quality control on data used, however when errors are detected the data has to simply be excluded.

Relative to in-lab research, citizen science is limited by a lack of controls. By nature, each participant is being tested in spaces with different spatial layouts, lighting conditions, and a host of other perceptual features. This may impact performance and overall data quality (Smith et al., 2022). There are also limited controls when guardians act as active experimenters (e.g., are actively presenting stimuli as seen in Stewart et al., (2015) vs. recording responses to stable stimuli like in Smith et al., (2021,2022). Guardians typically receive written and/or video instructions, but these can be misunderstood. A further limitation of traditional asynchronous citizen science, particularly when considering guardians as active experimenters, is an inability to remedy errors. In contrast to in-lab research, where mistakes can be fixed and trials can be repeated, guardian experimenters participating in asynchronous research likely do not know or recognize if an error is made. One solution to this limitation is to conduct synchronous research, where a trained researcher instructs and supervises the guardian to act as an experimenter. This method has previously been conducted in another companion species, cats (Fukimoto et al., 2023). Having synchronous citizen science provides many of the advantages of traditional citizen science approaches (i.e., naturalistic data in an ecologically valid environment, the inclusion of a broader population, etc.) however it also provides the opportunity for advanced and remedial instructions. This may increase confidence in the accuracy of the data, allowing for individual trials to be repeated or excluded as appropriate. Further, having synchronous supervised testing can help researchers avoid having to exclude data due to common problems like misplaced camera angles. Finally, a synchronous approach may allow for more complex experimental procedures to be used as continued instructions can be provided during the session.

In the present studies, we are using a remote supervised approach, specifically using the video-chat software Zoom to guide dog guardians to act as experimenters (Byrne et al., 2023). To validate the feasibility and accuracy of this method, we have chosen two tasks that we have strong expectations for dog performance on, and are conceptually replicating them in the home environment with a virtual experimenter. In study 1, we evaluated dogs' performance on a two-alternative forced choice task between a treat and an empty plate. In study 2, we explored dogs' looking-back behaviors on a naturalistic variation of an impossible task.

Study 1: Object Choice Task

In study one, we presented dogs with a two-alternative forced-choice task between a treat and an empty plate similar to previous in-lab tasks (Espinosa et al., 2021). We chose this task because dogs are generally successful in it in the lab (~83%, Espinosa et al., 2021). Dog guardians were trained to act as experimenters and presented their dogs with a total of 12 trials. We predicted that dogs' would perform similarly to in-lab, meaning that they would perform significantly above chance. However, it was also possible that dogs could perform worse on the task, potentially due to the increased distractions in the home environment. Alternatively, it was possible that dogs could have performed better, as they had reduced levels of stress and anxiety when completing the task in a familiar context (vs. in the lab).

Methods

Participants

Participants were 118 pet dogs (59 Female, Mean Age = 62.47 Months). An additional 18 dogs were excluded from the study due to (1) guardian-experimenter error resulting in the dog eating the treat after choosing the empty plate (10 dogs were excluded for this reason) or resulting in the dog being unable to treat after choosing it as the plate was taken away incorrectly (1 dog was excluded for this reason), (2) dog failed to complete all warm up and test trials (6 dogs were excluded for this reason), (3) video-experimenter error resulted in a skipped trial (1 dog was excluded for this reason).

Testing Set Up

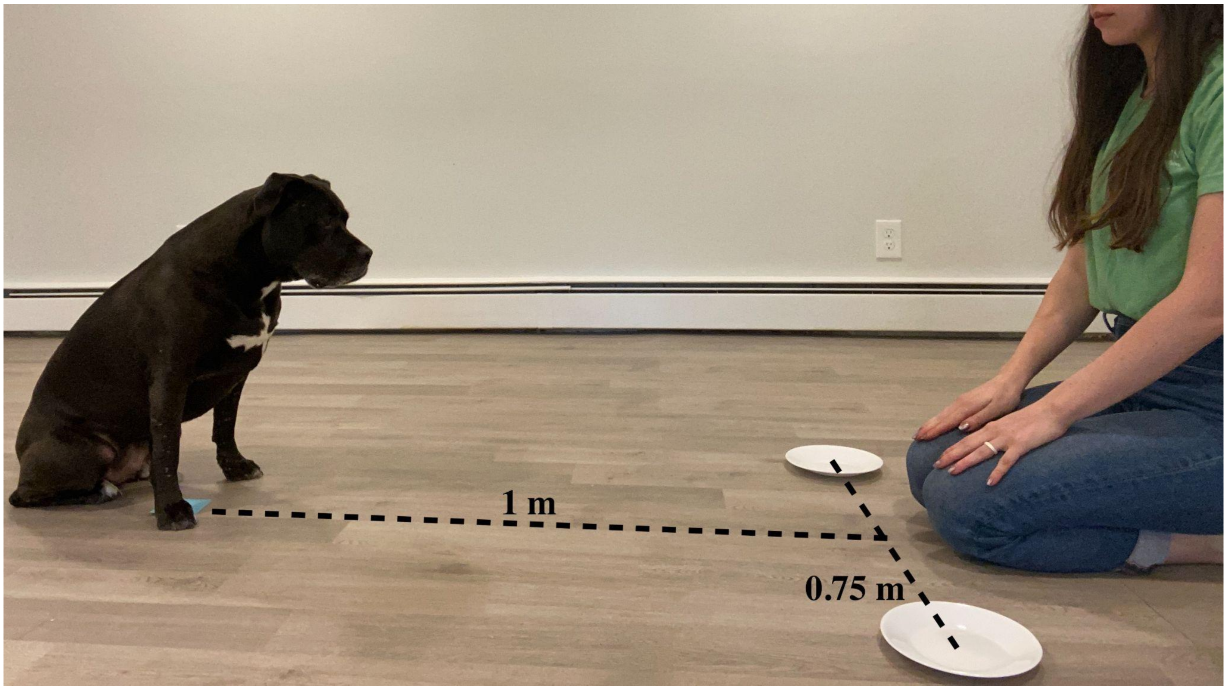
The study was conducted in an open room in the guardian's home. Dog guardians were first instructed to mark their floor using tape or sticky notes to create a T-shape made of 3 markers (see Figure 1). This mimicked the procedure used in a lab environment and helped guardians to be consistent in their placement and set-up on each trial. Guardians sat at the center of the top of the T-shape. Dogs waited at the base of the T shape, approximately 1m away from their guardian. Plates were located approximately 0.75m apart from each other.

Procedure

Dog choices were defined throughout our study as making physical contact with either the food item or the plate the food item was on. Choices were recorded by the experimenter on Zoom. In the event that a dog failed to make a choice for > 30 seconds, the trial was repeated (this occurred on 6 out of 1416 trials). Dogs waited while the guardian placed down plates with treats as instructed by a researcher over Zoom. When a second person was available, dogs were held in their waiting position by this second person. Otherwise, guardians were instructed to have their dog stay at the waiting position using the command their dog would respond to best. After the guardian completed the placement of plates, they released their dog to make a choice between the two plates.

Figure 1

Experimental Set-Up for Study 1



Note. Dog guardians marked all locations in advance. The Zoom-enabled device was placed so that both the plates and the dogs' faces were all visible.

To familiarize dogs and guardians with the procedure, we first conducted warm-up trials. During warm-up trials, dogs were shown a single plate with a treat on it that was placed directly in front of their guardian. Once the plate was on the ground, the guardian verbally released their dog from the waiting position to eat the treat off of the plate. We repeated this procedure for a minimum of 3 trials, or until both guardians and dogs were comfortable (maximum of 6 trials observed in our sample).

After completing warm-up trials, the guardian presented two plates, placed just in front of their knees. The guardian placed the plates, one of which had a treat on it and the other which was empty, sequentially, as directed by an experimenter over Zoom. The order of placement (treat or empty plate placed first) as well as the side the treat was on was counterbalanced. After placing both plates onto the ground, the guardian verbally released their dog. If the dog chose the plate with the treat on it, they were allowed to eat the treat. If the dog chose the empty plate, the plate with the treat was removed, and they did not receive any treats on that trial.

Data Coding & Analysis

As mentioned above, dogs' choices were classified as making physical contact with either the plate or the item on the plate. Initial choices were recorded by the experimenter over Zoom. 25% of videos (n = 30 dogs) were re-coded for dogs' choice by a naive coder. Interrater reliability was very high (358 / 360 trials, 99.44%). In the event of any disagreement between the original Zoom experimenter and the re-coder (occurred on 2 / 360), the trials were re-coded by the first author (MHP). All statistical analyses were conducted in R version 4.1.2 (R Core Team, 2021).

Results

Dogs and guardians were both generally successful at warm-up trials. The majority (n = 92 / 118 dogs) completed the warm-up in our predetermined minimum of 3 trials. Further, the maximum number of warm-up trials required in our sample was 6 trials (n = 2 / 118 dogs). During our object choice task, on average, dogs chose the treat M = 10.06 / 12 trials or 84%, SE = .19. This is consistent with past findings from in-lab work, where dogs chose the treat (over the empty plate) on 8.3 / 10 trials (83%) (Espinosa et al., 2021). A one-sample t-test showed that dogs chose the treat plate significantly more than chance levels (chance being 6 / 12 trials or 50%), $t(117) = 20.87$, $p < .001$. We also conducted a linear regression to explore if the dog having a second guardian to handle them (vs. waiting alone) or the number of warm-up trials they completed had an impact on the total number of times they chose the treat. We found no significant effect of having a handler present (35 did not have handlers, 83 had handlers), $t(115) = -.48$, $p = .63$. We also found no significant effect of the number of warm-up trials dogs completed (M = 3.28, SE = .06), $t(115) = -1.30$, $p = .20$.

Dogs were also equally successful across trials. We conducted a generalized mixed-effects model exploring dogs' choices for the treat vs. empty location as predicted by the trial number, with a random intercept for each participant. Using a mixed-effects model, we found that trial numbers did not predict dogs' choices, $\chi2 = 3.43$, $p = .06$. There was also little variance between dogs (SD = 1.26). This is likely because dogs were very successful at choosing the treat from trial 1 (M = 0.86, SD = .34). This is consistent with in-lab data that also does not find evidence of learning across the task (Espinosa et al., 2021).

Discussion

Overall, our findings were consistent with in-lab research. More specifically, dogs tested by their guardians in their homes were equally successful as dogs in the lab on a simple two-alternative forced choice task. This also suggests that guardians, on simple tasks, can easily be trained to act as experimenters. Guardians and dogs did not require extensive practice prior to testing and for the majority of dogs three trials (our minimum, consistent with in-lab work with a trained researcher, Espinosa et al., 2021) were sufficient to have the dog engaged and the guardian comfortable performing the tasks. Further, we found no evidence that having a handler to help position the dog and facilitate their waiting made any impact on their success at locating the treat. Put another way, dogs in our sample did equally well when they had a second guardian present to hold them at their start line as when they waited independently. It is possible that dogs who did have a second guardian present would have struggled to wait independently, and all dogs who waited independently had strong stay/wait commands. What we can conclude from these results is that future remote research can conduct research in single-person households, or when only one person is available to conduct the session.

Study 2: Dogs' Looking Back Behavior

In Study 2, we aimed to explore if dogs' looking back behaviors on an impossible task are consistent in homes and in the lab. On a similar task to Mashall-Pescini et al., (2013), we explored if dogs would look back to their guardian more when their guardian was attentive vs inattentive when presented with an impossible task (specifically a bag of treats placed in an inaccessible location). We predicted that dogs would look more at the guardian when the guardian is attentive (vs. inattentive) in line with prior findings in the lab (Marshall-Pescini et al., 2013). Exploring dogs' looking behaviors in a social setting in response to different social cues from their guardian is particularly well suited for virtual testing. It was possible that dogs would behave differently in a similar setup to Mashall-Pescini et al., (2013) in a more naturalistic setting. This study also allowed us to evaluate the virtual in-home validity of another common paradigm used in lab settings, specifically the recording of looking times. This study was pre-registered[1].

Methods

Participants

Participants were 40 pet dogs (at least 17 males and 18 females, average age 5 years, further demographic data included in supplementary materials). An additional 11 dogs were excluded from the study based on pre-registered criteria. Specifically, dogs were excluded if (1) Dog was not treat oriented (i.e., they did not eat all of the warm-up treats across all three trials – four dogs were excluded for this reason), (2) Dog pulled out the bag of treats under the furniture (two dogs were excluded for this reason), (3) citizen scientist did not follow directions (one dog), and (4) If the dog remained out of frame for more than half of the time (15 seconds) persisting across all 3 trials (four dogs were excluded for this reason).

In addition, 38 total trials were excluded based on pre-registered criteria. The majority of excluded trials were due to citizen scientist error (i.e. talking during trials, not following directions; 16 trials). In addition, trials were excluded if either the citizen scientist or the dog were not visible on the video for more than half of the test trial (15 sec; 10 trials). Trials where distractions in the environment captured the dog's attention for more than three seconds were excluded (6 trials). If the dog did not eat the warm-up treat the trial was excluded (4 trials). If the dog solved the impossible task by retrieving the treats on one at trial, the trial was excluded (2 trials).

Testing Set Up

The study was done in a spacious room in the living space of the guardian. We used the area under a couch or other piece of furniture as an unreachable area. The dogs could not reach

[1] Link to the pre-registration for Study 2: https://aspredicted.org/blind.php?x=4gn2kn

the bag of treats that was placed there without the assistance of their guardian. Filming was done through Zoom on a guardian's laptop, tablet, or device that can record clearly. To set up the study in the best way to limit low-quality video recordings, guardians were asked to place laptops or cameras in areas that could capture the dog, guardian, and furniture in the frame. No other people or dogs were allowed to interfere with the experiment, and if they appeared the trial was excluded as a distraction.

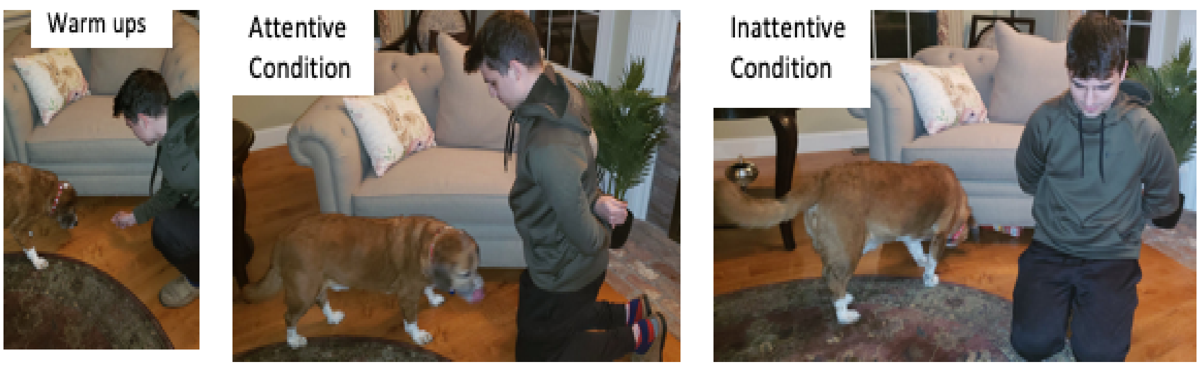
Procedure

The study began with warm-up trials to get the dogs focused on the goal of getting treats. Dog guardians were first instructed on how to conduct the study by a researcher over Zoom. Guardians then brought in a plastic bag filled with treats and showed this bag to their dog. It was then placed under the furniture in the unreachable location while the dog was watching. The guardian then gathered two treats from the bag under the couch, and placed both treats on the floor, in front of the furniture. One treat was placed on the right side of the furniture, and one on the left. After the dog ate both treats, the testing trials, or the Still Phase, began.

During the Still Phase, there were two different conditions; the attentive condition, in which the guardian watched their dog, and the inattentive condition, in which the guardian positioned their body away from the unreachable location, and looked down (Figure 2). 20 subjects were randomly assigned to each group (attentive group or inattentive group). In the attentive condition, the guardian sat down and watched their dog for 30 seconds while the experimenter on Zoom kept track of time. Guardians were instructed to keep their hands behind their backs and watch their dogs passively. If their dog made eye contact with them, they were asked to nod and smile back (as in Marshall-Pescini et al., 2013). In contrast, in the inattentive condition, the guardian still sat with their hands behind their back, however, they sat facing in the opposite direction (facing away from the furniture/unreachable location). They were told to look down for 30 seconds and not make eye contact or communicate with their dog. See Figure 2 for contrast across conditions. In both conditions after 30 seconds elapsed, the video experimenter instructed the guardian to prepare to re-set for the warm-up phase. This procedure (1 warm-up, 1 Still Phase) was repeated a total of three times.

Figure 2

Experimental Set-Up for Study 2



Note. Dogs first received warm-up trials (Left). Dogs then experienced either the Attentive (Middle) or Inattentive (Right) condition.

Data Coding & Analysis

Videos from sessions were coded for five behaviors. Dependent variables included (1) Looking back, a state event defined as the amount of time the dog spent with eyes and nose oriented at the guardian above the shoulders (2) latency to first look, a state event defined as the time from the start of the trial (when the dog ate the second treat) until the dog first looked back at the guardian (if the dog did not look on a given trial, they were assigned the maximum duration of 30 seconds), (3) number of gaze alternations, a point behavior inspired by a coded behavior in a study by Nawroth et al., (2016) where gaze alternation is looking at both the guardian and the unreachable location within a two second period, (4) latency of first gaze alternation, a state event defined as the time it took for a dog to first look at both the guardian and the unreachable location within a 2 second time window (if the dog did not gaze alternate on a given trial, they were assigned the maximum duration of 30 seconds), and (5) attempted solving behaviors, a state event defined as the amount of time the dog's front paws or nose went under the barrier (e.g., couch). The five behaviors were all coded for the three trials using BORIS (Behavioral observation interactive software; Friard & Gamba, 2016).Two coders coded 100% of all five behaviors for all trials. One coder was the second author (ZT) and the other was a coder blind to the hypothesis of the study. Reliability for the behaviors was $r = .92$ for looking back, $r = .70$ for latency to first look, $r = .37$ for gaze alternations, $r = .38$ for latency to first gaze alternation, and $r = .81$ for attempted solving behaviors. Given our low reliability for some measures, we ran all analyses reported below with both sets of coders' codes and found the same pattern of significant results for both coders. We report the results from the second author's (ZT) coding here.

Statistical analyses were conducted using R statistical software (version 4.0.3) (R Core Team, 2021). Predictors of interest were the guardian's attentional state (attentive or inattentive), trial number, and the interaction between attentional state and trial number. Data were analyzed for each of the five dependent variables with linear mixed models (LMM) using the R package 'lme4' (Bates et al., 2015). Gaze alternation was fit as a Poisson distribution given that it is a count variable, and all other variables were continuous distributions. To control for repeated measures, subject identity was included as a random effect. In mixed model analyses, we first examined a null model, which included only subject identity. We then compared the null models with full models that included all predictor variables and their interactions. Model comparisons were conducted with likelihood ratio tests.

Results

Our models for looking back and gaze alternation revealed that subjects' looking was predicted by condition (LRTs: $Xs^2 > 6.37$, *p*s < .003), such that dogs looked back longer in the attentive condition (*M* = 5.96, *SE* = 0.88) than in the inattentive condition (*M* = 1.05, *SE* = 0.51) and alternated their gaze more in the attentive condition (*M* = 0.57, *SE* = 0.12) than in the inattentive condition (*M* = 0.17, *SE* = 0.06). See Figure 2. No other factors or interactions were significant predictors for looking back or gaze alternation (LRT: *p*s > .35). Our models for latency to look back and latency to gaze alternate revealed that subjects' looking was predicted by condition (LRTs: $Xs^2 > 6.36$, *p*s < .012), such that dogs had a greater latency to look back in the inattentive condition (*M* = 21.90, *SE* = 1.79) than in the attentive condition (*M* = 9.73, *SE* = 1.19) and a greater latency to gaze alternate in the inattentive condition (*M* = 25.64, *SE* = 1.50) than in the attentive condition (*M* = 19.61, *SE* = 1.53). See Figure 3. No other factors or interactions were significant predictors for latency to look back or latency to gaze alternate (LRT: *p*s > .22). Our full model for solve attempts was no better at predicting solve attempts than our null model (*p* = .277).

Discussion

In line with the results of Marshall-Pescini and colleagues (2013), we found that when dogs' guardians were attentive, dogs looked at their guardians for longer periods and had a shorter latency until the first look, than when their guardians were inattentive. These findings give support to the idea that looking back is a social tool that requires a human who is also being social. Dogs may be looking back because they are seeking help (e.g., Miklósi et al., 2003; Passalacqua et al., 2011). An attentional state of the human is important for dogs to identify if the guardian is available to be a helper. However, there is a possibility that dogs simply look back at the human because the human is a salient thing in their environment that is associated with prior reward history (Lazzaroni et al., 2020). Although, if the human was solely a salient thing in the dog's environment, then the orientation of the human would not impact the looking behaviors of the dog.

General Discussion

In study 1, we found that consistent with past work in the lab (Espinosa et al., 2021), dogs are easily able to succeed on a two-alternative forced-choice task. Dogs chose the treat significantly more than the empty plate. Study 1 showed that trial-based approaches are feasible to conduct over Zoom with dog guardians acting as experimenters. In study 2, we found that when dogs' guardians were attentive, dogs looked to their guardians sooner and for longer, as compared to when guardians were inattentive. This is also consistent with past work, (Marshall-Pescini et al., 2013) and shows that looking-time-based studies can also be conducted in a home environment via Zoom. In sum, our results suggest that Zoom based studies can provide accurate data.

While we found comparable data to in-lab studies, there are obviously some limitations. First - relative to in-lab approaches, there are significantly fewer controls, and not all studies are possible. Both studies presented here did not require specialized apparatuses or specific equipment, making them easy to conduct with materials that dog guardians have in the home already. Research questions requiring tightly controlled demonstrations or specific stimuli may not be appropriate to explore using this method. Further, relative to in-lab research there is significant potential for technical difficulties. In part as a result of the COVID-19 pandemic, most dog guardians contacted were relatively familiar with accessing Zoom or a similar software, however not all were previously comfortable using computers. Additionally, finding the correct camera angle to get both the guardian and dog in frame was a challenge that does not exist in-lab.

There were also significant advantages to conducting studies over Zoom. We were not constrained geographically when recruiting, and our participants could live anywhere in the world. Further, we were able to include dogs who are anxious or uncomfortable meeting new people that would not have participated in lab. There were also significant advantages when scheduling dog guardians, relative to in-lab work, as there was no travel time or logistics required. Dogs did not have to have any acclimation time to the space, something typically required in lab studies. The inclusion of a more diverse sample of dogs in studies conducted via Zoom may help to increase the generalizability of results.

Dog guardians acting as experimenters is by no means a new method, and as previously discussed past citizen science approaches have had guardians collect data on their dogs asynchronously and submit the data (i.e., Stewart et al., 2015). Relative to our Zoom studies, these asynchronous studies require much less time on the part of the experimenter and may be able to get a more global sample as they are not limited in scheduling by time zones. However, by having studies conducted synchronously, we are able to catch errors and clarify instructions with dog guardians before data is submitted. By having a trained experimenter supervise the recording and collection of the data, we can be confident in our results and end up with video data that can be re-coded for reliability after the session. Further, any data where errors did occur was easily excluded and avoided influencing our results.

In sum, over two studies we have shown that collecting data via Zoom with guardians acting as experimenters provides accurate data. This method may not be appropriate for all future research questions but can help researchers acquire larger and more diverse data samples while maintaining a high quality of data.

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Supplementary Materials

Order Tested	Participant ID	Condition	Sex	Breed	Age at time of test
1	3154	Attentive	Female	Golden Retriever	2
2	3115	Inattentive	Female	Mixed	9
3	3661	Attentive	Male	Mixed	6
4	3067	Attentive	Male	Tibetan Terrier	7
5	3106	Inattentive	Female	Mixed	2
6	3418	Inattentive	Male	Mixed	2
7	3040	Inattentive	Female	Labrador Retriever	4
8	3043	Attentive			
9	3241	Attentive	Female	Golden Retriever	4
10	3634	Attentive	Female	Australian Labradoodle	4
11	3121	Inattentive	Male	Mixed	10
12	3379	Inattentive	Male	Wheaten Terrier	1
13	3490	Inattentive	Male	Mixed	1
14	3700	Attentive	Male	Mixed	0
15	3451	Inattentive			
16	3613	Attentive	Female	Toy Poodle	8
17	3259	Attentive	Male	Pembroke Welsh Corgi	0
18	3148	Inattentive	Female	Mixed	10
19	3607	Inattentive	Female	Mixed	3
20	3337	Attentive	Female	Mixed	4
21	3676	Attentive	Male	Mixed	3
22	3682	Attentive			
23	3499	Inattentive	Male	Maltese/Poodle Mix	11
24	3166	Attentive	Male	Labrador Retriever	2
25	3298	Inattentive	Male	Belgian Tervuren	2

26	3811	Inattentive	Female	Australian Shepherd	0
27	3625	Attentive	Male	Mixed	3
28	3820	Inattentive	Female	Mixed	3
29	3805	Attentive	Female	Mixed	2
30	3832	Attentive	Female	Mixed	3
31	3745	Inattentive	Female	German Shepherd	8
32	3838	Inattentive	Female	Mixed	5
33	3853	Inattentive	Male	Mixed	9
34	3646	Attentive	Female	Rat Terrier	21
35	3751	Inattentive	Male	Mixed	2
36	3904	Attentive	Male	Border Collie	11
37	3880	Inattentive	Male	Mixed	8
38	3958	Attentive			
39	3052	Inattentive	Female	Labrador Retriever	5
40	4006	Attentive			

Table 1. Demographic data for Looking back study. Five dogs have missing data because the owners declined to provide it.