Abstract

The object choice task is a simple but effective way of testing the ability of domesticated dogs to follow human instruction in a lab setting. In object choice, dogs receive a food reward for choosing the proper object as directed by a human indicator. Many studies have confirmed the ability of dogs to perform this task at above chance (defined as 50% correct) levels. Because human males may have played a major role in the early domestication of dogs I tested the hypothesis that dogs may be more attentive to instructions provided by human males than those provided by females. I used the gaze-and-point variation of the object choice task to compare the performance of 21 dogs to the male and the female human indicators. Dogs performed above chance for both the male and the female indicator, but performed significantly better for the male indicator, regardless of dog age or gender of the primary trainer. Results support the hypothesis that dogs are more attentive to the male indicator than the female indicator, but further studies are needed to understand the full implications of this result.

Introduction

The domestication of plants and animals has occurred for thousands of years. Without the domestication of crops such as corn, cabbage, wheat, or barley, humans may have remained hunter-gatherers. The domestication of animals such as cattle, sheep, pigs, and chicken provided consistent sources of protein, which reduced the need to hunt (Diamond 2002). Horses were used for labor and transportation, and dogs were domesticated to fill many roles including protection, hunting, companionship, and a source of food. In most countries, the modern day dog has been bred specifically

to live in human environments, respond to human commands, and be just as man sees them today: friends.

Domesticated animals across species have a few traits in common: smaller stature, tails that curl, and "floppy" ears, all of which give the impression of being more juvenile and, thus, more appealing to people (Ratliff 2011). These changes also occurred in *Canis familiaris*, or the domestic dog. While the conscious intention of humans to domesticate for these traits is not likely how the change came about, these traits allowed the dog to continue to be seen as "cute", "cuddly", or "friendly", and secured dogs a place next to ancient man's fire.

Grey wolves, known hunters, are the accepted ancestors for the modern dog (vonHoldt, et al., 2010). Thousands of years ago, it is possible that man used wolves for hunting by gathering the kill of the wolves, which the tamest wolves may have allowed. It is also possible that the wolves that were most comfortable eating human camp scraps were the ones who were brought closer, fed, bred, and used for purposes of hunting later (Coppinger 2001). Eventually, these tamed wolves were bred and became a separate species altogether. This is the origin of *Canis familiaris*, which is the dog we know today (Koler-Matznick 2002).

Animals that are perceived to be intelligent, such as wolves and chimpanzees, do not have the same kind of relationships with people that dogs do. The innate ability for a dog to react to a human cue and have an "intuitive sense" of what a person is thinking seems to be present only in *C. familiaris* (Morell 2009). Through research, it has been determined that the ability of a dog to rely on a human cue is not inherited from the ancestral wolf and is not due to being raised in a human environment. This behavior is rather the result of thousands of years of domestication (Hare et al. 2009). This is also known as the domestication hypothesis, which is "that dogs' specialized skills arose as adaptations for

interacting and communicating in the human social environment in which they have lived for more than 10,000 years" (Tomasello and Kaminsky 2009).

Chimpanzees and wolves do not have the innate ability to follow human signals or use human communication as well as the domestic dog does (Kirschhofer et al. 2012). Though chimps and wolves may learn to follow these cues after numerous trials, dogs can do it from the time they can open their eyes (Hare et al. 2002). Dogs and human toddlers both show an ability to learn about human communication through trial and error. Human babies and toddlers will make a decision on which object to choose based on where the object was before and not where the human indicates the object is now. Innately, domesticated dogs will go to an object that a human points to. When a human is not there to give direction, dogs will go to where they previously learned the object was because they "know" where the object used to be. Known as the A-not-B error, this behavior may reflect a sensitivity that dogs have to follow human communicative cues (Kis et al. 2012). This is a distinctive human communication skill associated with learning. Basically, dogs have the ability to search for something because they learned that it used to be there. This is how human toddlers make sense of the world. Choosing objects is not random: it is reasoned through by using previous experience (Tomasello and Kaminsky 2009). The A-not-B error shows that dogs have strong similarities in how they communicate with humans as humans do with each other (Topál et al. 2009). Dogs even seem to be as intelligent as human toddlers at choosing objects based on previous experience. It is unknown how dogs acquired this ability. Dogs may have picked up on other methods of human communication through domestication in addition to object choice. The A-not-B error experiment reveals another side of human-dog interaction that is not as well understood as the object choice task. By understanding object choice, learned behaviors in dogs and the domestication process may be better understood.

Humans have been hunting with the aid of dogs for thousands of years. In these situations, the amount of communication between the human and the dog is extensive and important for the success of the hunt. Males have traditionally been the "breadwinners" in this regard by going out for the hunt while the females stay home. Human males were usually the ones to bring the meat home, "putting them in the role of providers" (Stanford 2001). This means that during the domestication of dogs, the individuals giving the hunting signals, the nonverbal cues, such as following eye gaze, and the physical commands, such as pointing, were usually the males. Females often did not provide verbal and nonverbal commands to dogs during hunting.

The object choice task is an exhibition of these skills in the laboratory. Object choice is the ability to choose an object, such as food, based on human body signals, voice commands, human gaze following, or other human given indications for choosing the proper "object of choice" (Hare and Tomasello 1999). Object choice tasks require the subject to choose an object based on a given direction. Dogs will follow the communicative human actions rather than acting on their own, even at the expense of losing a reward (Range 2009). Dogs are especially good at this task. In the object choice task, two containers, one of which is hiding a reward, are used to give the dogs a choice. The human indicator uses any one of a few methods to get the dogs attention and indicate which of the containers holds the reward, which is generally food of some sort. In some studies, other dogs are used to indicate which of the containers has food in it. In either case, the dog must make a choice, which is indicated by touching one of the two containers. If the dog chooses correctly, then it receives the reward. If not, then the indicator will remove both containers and start again. In studies using wolves, experimenters observed that wolves can perform object choice, but it requires extensive training and exclusive parameters, such as physically touching the baited container, to garner a correct response at

chance levels (Viranyí et al. 2008). Chimpanzees (and other primates) can take dozens or more trials to learn how to perform the object choice task. They do not spontaneously perform at the above-chance levels that domesticated dogs do (Hare et al. 2002).

Studies have shown that dogs are better at following pointing gestures rather than gaze gestures when choosing the correct object. Chimps and wolves also follow this pattern. Dogs may perform in this way because they are less likely to follow human eye-gaze (Miklósi et al. 1998). The more straight-forward point direction tends to result in more effective experiments. Taking into account that most studies use pet dogs as opposed to wild, feral, or shelter dogs may skew results and is basis for further experimentation with object choice and how it works in *all* dog cases.

Breed of dog is relevant only when comparing within the species *Canis familiaris* and not related dog species (such as the dingo, African wild dogs *Lycaon pictus*, etc). Though some breeds outperform others when it comes to the distal-point method of object choice, all breeds are capable of performing the task at above chance levels (Dorey et al. 2009; Gácsi et al. 2009). These differences between breeds may simply be attributed to socialization level or eyesight capabilities, but this study may provide a base for more trials of this sort. At this point, there are no conclusive studies supporting that some breeds are significantly better at this task than others.

It is known that dogs follow human indicators in object-choice tasks, but it is possible that they are keener to follow male indicators than female indicators because of the history of communication during hunting that was part of the domestication process. If it can be determined that dogs respond better to male indicators than female indicators, the progression of human-dog communication may become clearer. I will determine whether the performance of dogs on the object-choice task may differ according to the gender of the human indicator. I hypothesize that the ability of *C. familiaris* to

use human direction is affected by the gender of the human indicator, and that dogs will respond better to direction from a male human indicator than from a female human indicator.

Methods

I worked with volunteer dogs of all breeds, age, and training levels that were not familiar with me or the male indicator. The dogs were tested in their homes unless this was not possible (in which case they were tested in my apartment).

Two indicators were used during the trials, me and a male student who performed all of the male trials. We are of similar height and dressed similarly for the trials.

Two green opaque bowls were scented with dog treats (Ol' Roy's Bark'n Bac'n), which were used in each experiment unless the dog would not eat this type of treat. In these cases, we used the owner's own treats. I pre-scented the bowls to prevent the dog from choosing a bowl based on smell.

The dogs were familiarized with the procedure during 8 mock trials. Both the male indicator and I performed four mock trials each. The indicator got the dog's attention by saying the dog's name, making eye contact with the dog, and dropping food into a bowl in view of the dog. Four trials were performed by one indicator and then four were performed by the other. Treats were dropped into alternating bowls. The male indicator and I alternated who went first with the mock trials with each dog. The purpose of these trials was so that the dogs learned that either indicator could provide food and that a treat may be present in either bowl. Once the dog acquired the treat, it was praised and returned promptly to the starting position by the owner.

For data collection trials, the method used was gaze and point. The dogs were kept out of sight of the bowls while the bowls were baited to eliminate "cheating". The dogs were then brought into the room with the indicator (either male or female and, again, alternating with each dog) and the other

indicator out of sight. The indicator who went first was chosen by trial, with the male going first for half of the trials and the female going first for half. The dog's name was called, eye contact was made with the dog, and the informant gazed at the baited bowl and pointed at it briefly (about one second). The dog was allowed a chance to make a choice before the gesture was repeated. The choice was considered correct if the dog came within six inches of the bowl. If the dog didn't move toward a bowl after the gesture was done, the gesture was repeated. If the dog had any other response than going to the correct bowl, the response was marked as incorrect. Six trials were performed by each informant. The dogs were praised after a correct choice. If the dog chose incorrectly, the bowls were picked up by the indicator and the indicator turned away from the dog. After every trial, the dog was taken back out of the room by the owner and the bowls were re-baited. Immediately before, during, or immediately following the trials, owners filled out a questionnaire about the amount and type of training the dog had, age of the dog, breed, general health of the dog, gender of the primary caregiver of the dog, and gender of the primary trainer of the dog to assess how these variables may have impacted the trials.

The results were analyzed using a t-test comparing the proportion of correct responses to the proportion expected by chance (0.5), a paired t-test comparing the number of correct male informant trials to the number of correct female informant trials, and by one way ANOVAs using dog age and gender of the primary dog trainer as the independent variables. Dogs that participated in the trial are shown in table one.

Dog Name	Age	Correct Trials (M)	Correct Trials (F)	Trainer Gender	Owner Gender
Oakley	4 months	3	3	F	F
Foxie	2.5 years	6	4	F	B
Thunder	6 years	4	3	B	B
Chubbs	1.75 years	5	5	M	M
Apollo	2 years	6	6	M	M
Bentley	5 months	3	2	M	M
Roxie	1 year 7 months	5	3	M	M
Calo	4 years	4	5	F	B
Teaka	4 months	5	4	F	F
Luke	1.5 years	6	6	F	B
Leia	1.5 years	6	5	F	B
Elmo	5 years	5	4	F	B
Maggie	10 years	5	4	F	B
Zeus	9 years	6	5	F	B
Holly	9 years	6	6	F	F
Abby	7 years	6	5	F	F
Maeby	5 years	3	4	F	F
Gizmo	6 years	1	1	F	F
Bella	10 years	5	4	F	F
Lyla	2 years	5	3	M	M
Lennox	1 year	3	2	F	F

Table 1: Dog name, age, trials correct (male and female) and gender of the primary owner and trainer

Results

Dog performance relative to chance

Dogs performed significantly better than chance for both male (76.9% , $t=5.47$. $df=20$, $P<0.001$) and female (66.7%, $t=3.33$, $df=20$, $P<0.0031$) indicators.

Effect of the gender of human informant on the dog's performance

There was a significant difference in the performance of the dogs based on the gender of the human informant. The difference (correct proportion) between male indicator responses vs. female indicator responses is show in figure 1. Statistically, dogs performed better for the male indicator than for the female indicator by 10% (matched pairs $t=3.28$, $df=20$, $P=0.0019$).

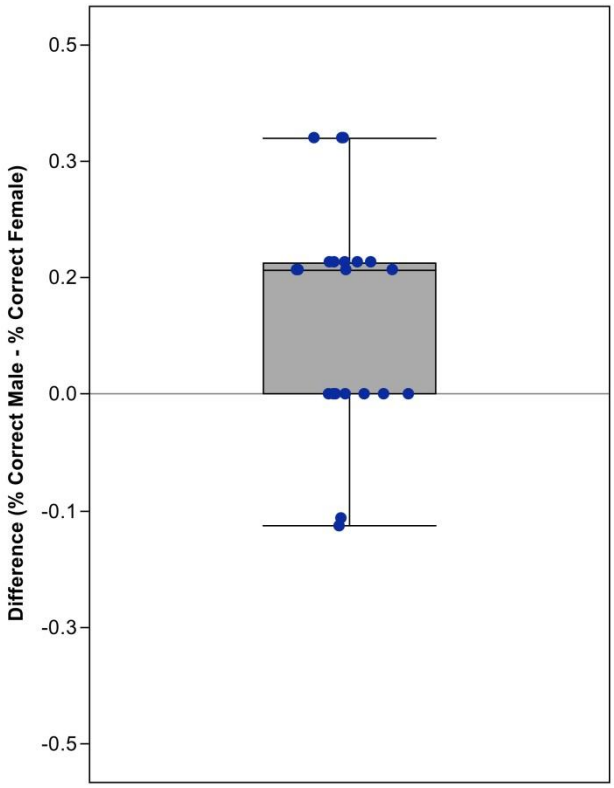


Figure 1. Box plot showing the difference in percentage of trials performed correctly for the female vs. male human indicator. Points above the zero line indicate dogs that performed better for the male indicator, and points below the line indicated dogs that performed better for the female indicator.

Effect of trainer gender on the dog's performance

There was no significant relationship between the gender of the dog's primary human trainer and the dog's response to either the male indicator (one way ANOVA $F_{2,18}$ =0.17, P=0.85) or female indicator (one way ANOVA $F_{2,18}$=0.24, P=0.79) (Fig. 2). It can be noted, however, that there was less of a difference in responses to male and female indicators when the dog's trainer was female (Fig. 2).

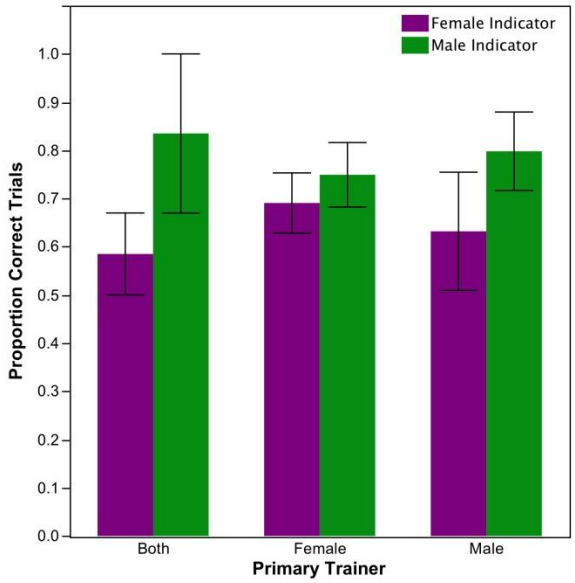


Figure 2. Proportion of trials performed correctly for the male and female human indicators based on the primary dog trainer being a male, female, or both male and female. Error bars represent the standard error.

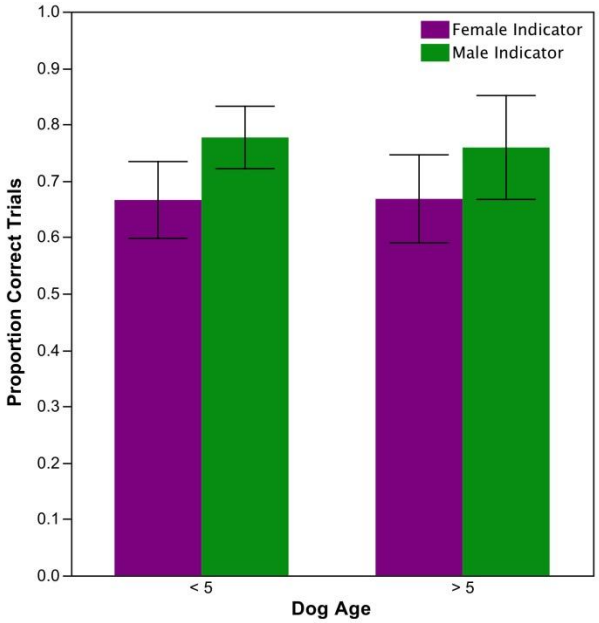


Figure 3. Proportion of trials performed correctly for the male and female human indicators based on the age of the dog in years at the time of the trials. Error bars represent the standard error.

Effect of dog age on the dog's performance

There was no significant effect of dog age on dog performance in response to the male indicator (ANOVA $F_{1,19}$=0.03p=0.86) or female indicator (ANOVA $F_{1,19}$=0.00, p=0.99; Fig. 3).

Discussion

The object-choice task is an effective and objective way of demonstrating the innate ability of *Canis familiaris* to follow both human visual and vocal cues. None of the dogs that participated in this study had performed this type of task before, so they had no way of learning the task beforehand. It was imperative as well that the dogs did not know either the male indicator or the female indicator prior to the test to prevent any bias in responding to cues. Each trial was conducted in exactly the same manner and in a familiar environment for the dogs to prevent any sort of anxiety responses due to being in a new environment, which could have affected the dog's performance. The owners of the dogs were present during the trials to alleviate stranger-generated anxiety as well.

The results of my study also suggest that the object-choice task was effective in measuring the ability of dogs to respond to human indicator behavior. The dogs responded better than chance for both the male and female indicator. This showed that the experiment was effective in fostering correct dog responses. The trials supported previous studies showing that dogs can follow human direction early in development and through late adulthood and regardless of whether the human is familiar or not (Hare et al. 2002; Merola et al. 2012; Udel, Dorey, and Wynne 2009).

My hypothesis that dogs would perform better for a male indicator than a female indicator was also supported; the male indicator produced roughly 10% more accurate responses than the female indicator (Fig. 1). Of the 21 dogs tested, 12 performed better for the male indicator, seven performed equally well for both indicators, and only two performed better for the female indicator.

Two other variables could have affected the outcome of the trials in favor of my hypothesis: voice tone and body build. Males characteristically have deeper voices than females do because of differences in hormones and their effect on speech organs. As a result of this, dogs may interpret male vocal cues as more commanding than those produced by females. However, I feel that this did not have a major effect in the higher dog performance for the male indicator because the only words that were spoken were the dog's name and the praise given to the dogs after correct trials. If more words had been used in the trials, I believe this could have been an important factor in dog response to the human indicators.

The second variable, body build, was obviously different between the male and the female indicator. The male had significantly more muscle and broader shoulders, making him appear larger. A larger physical build may potentially be seen by the dog as more commanding, causing the dog to respond better to the nonverbal gestures. Though I hypothesized that domestication interactions between humans and dogs may account for the difference in dog response, these other factors could have also played a role in the dogs' higher performance for the male indicator. Further studies that use males and females of identical height and build or non-verbal tests may aid in the interpretation the intricacies of dog-human communication and response to cues.

When observing the results of trainer gender and dog response, the dogs that had a primarily female trainer responded slightly better to the female indicator than the dogs that had both male and female trainers or primarily male trainers (Fig. 2). Although the effect of trainer was not statistically significant, this observation opens the door to further experimentation on the effects of trainer gender on a dog's response to male and female indicators. With further studies, a correlation between dog response and trainer gender may be established.

When considering the effect of dog age on response, there was no correlation between these variables. The dogs ranged in age from about five months to approximately 10 years. Young puppies are able to perform the object choice task at above chance levels in studies as early as nine weeks, and adult and elderly dogs have repeatedly been shown to perform this task at above chance levels (Gácsi et al. 2008; Hare et al. 2002). Because of this support, dog age can be neglected as a factor in following human direction.

In conclusion, dogs performed at above chance levels for both human indicators, but demonstrated significantly greater ability to follow the male indicator than the human indicator. Gender of the dog's primary trainer and dog age were not significantly correlated with the way the dog responded to the indicators. Further research could investigate any implications of the slightly increased response to the female indicator when the dog's primary trainer was female. Further research using multiple male and female indicators may also shed light on the tendency of dogs to follow the male indicator's directive more than the female's in this particular study.

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