Do domestic canines (*Canis familiaris)* understand human competence?

A Senior Thesis in Cognitive Science

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Abstract

Research in social psychology has established that competence is an important trait on which humans categorize one another, but comparative psychology has largely neglected competence as a mode to empirically examine social judgments. Because of the domestic dog's unique domestication history, this species offers specific insights into how experience in a human environment affects the degree to which humans use the concept of competence to evaluate others. In Experiment 1, we presented dogs with two experimenters, one who was competent at helping dogs during a fine motor task and another who could not complete the task. We then tested whether dogs approached or looked at the competent experimenter more than the incompetent one. We found that dogs did not differentiate between the competent and incompetent experimenters across four separate measures. In Experiment 2, we then presented dogs with a control condition to be sure that dogs could distinguish two humans with different amounts of food reward. Dogs developed a preference for the experimenter who had the food reward, indicating that dogs can track which humans can give a food reward, but not necessarily which humans are more competent. These results suggest that dogs do not actively take competence into account when developing preferences for humans.

Introduction

In human society, we are often faced with situations in which we must collaborate with unrelated individuals. In such cases, we often quickly and effortlessly make judgments about whether potential collaborators will have the skills, expertise, or status needed to help us. When faced with long lines to check out in a grocery store, we look for cashiers with speedy hands. When faced with a stubborn pickle jar, we hand it to our muscular friends. When faced with a social problem at work, we seek out high status colleagues. In short, humans quickly and automatically judge the competence of other individuals and use this information when seeking help from others.

Much work in social psychology has demonstrated that humans tend to use others' perceived competence as a factor when making quick social evaluations. Susan Fiske and her colleagues, for example, have found that adult humans automatically judge whether or not another person is competent and then proceed to use these judgments when forming attitudes towards that person (Fiske, Cuddy, Glick & Xu, 2007; Fiske, Cuddy, & Glick, 2007). Indeed, Fiske and colleagues' classic stereotype content model argues that competence is one of the two fundamental dimensions on which human stereotypes are based. Under this model, when people encounter a stranger, they immediately map this new individual onto the dimensions of competence and warmth based on their previous stereotypes concerning race, gender, political affiliation, and socioeconomic status. This mapping then affects the attitudes towards that individual. For example, populations that we tend to view as cold and incompetent (e.g. the homeless) are often viewed with frustration and anger, while those we view as warm and competent (e.g. housewives) are revered and loved. Regardless of the accuracy of these judgments, our quick perception of another individual's competence tends to dictate the affective responses that we feel towards that person even before we begin interacting with them (Weiner, 2005), which can substantively change general attitudes and behaviors. For these reasons, a better understanding of how humans perceive competence in others is crucial for understanding how we come to evaluate others socially.

Here we attempt to get at the evolutionary roots of human competence judgments through the use of a different subject population: non-human animals. Though our understanding of the representations underlying competence judgments has historically been explored by studying the perceptions and judgments of human adults, comparative cognition can provide an important new window into how perceptions of competence function and how these perceptions affect social evaluation. Though studying human adults is a direct reflection of how adults think, it can be difficult to parse out how human adults developed the capacities they possess. Comparative cognition uniquely addresses this issue by observing how other species of animals develop certain cognitive capabilities and asking where these capabilities come from (e.g. evolutionary roots, human domestication, ecological pressures). For example, comparative cognition can begin to parse out which parts of human cognition are the results of genetics by studying nonhuman primates, or socialization by studying domesticated animals. The investigation of how animals think reveals not only their current priorities in terms of survival and reproduction, but also their historical backgrounds and what caused them to arrive in this state of cognition.

As a result, comparative cognition is a unique lens to look at how competence perception develops in humans. Like humans, nonhuman animals must undergo meaningful social decisions every day, and one of the factors that affect these social decisions could be the competence of other individuals. If nonhuman animals develop social preferences towards the competent over the incompetent, then competence is a deeply ingrained trait in animals that does not require sophisticated human-specific cognition (e.g. linguistics) to understand and use in social judgment. Meanwhile, if the competence of others is not a trait perceived by nonhuman animals, then competence perception may be a mechanism only used by humans in social judgment, implying that it is a more nuanced social categorization of others and requires more sophisticated social skills.

To date, only a few studies have tested whether non-human animals recognize competence in others. Such work suggests that one non-human species – the chimpanzee – tracks competence in others and uses these judgments to inform their social decisions. For example, Melis, Hare, and Tomasello (2006) found that chimpanzees pick the better and more competent of two collaborators in a cooperative task. Chimpanzees were introduced to two chimpanzee collaborators, one of whom was demonstrably more effective in completing a food-obtaining task than the other. In a test trial, chimpanzee participants were given an option to release one of the collaborators from their enclosure so that this individual could help the participants obtain food. Chimpanzee participants tended to release the more effective individual in order to complete the task and obtain the food reward. As a result, chimpanzees must have realized the different competencies between their two potential collaborators and picked the one that was more competent.

These results indicate that chimpanzees are able to detect competence within members of their own species, a relevant skill due to their lives in a chimpanzee society - gauging the competence of other chimpanzees could be a critical mechanism for survival in the wild. However, running the study detailed in Melis, Hare, and Tomasello (2006) with two human collaborators may have yielded different results. Studies have demonstrated how chimpanzees cannot follow human social gaze (Itakura, Agnetta, Hare, & Tomasello, 1999) and pointing cues

(Povinelli, Reaux, Bierschwale, Allain, & Simon, 1997), indicating that chimpanzees have a limited capacity for understanding some of the standard social cues in humans. If chimpanzees are not following some of the foundational cues of human social cognition like social gaze and pointing, then they likely would not understand more nuanced aspects of social cognition like competence in humans. As a result, the chimpanzees' ability to detect competence may not be applicable to humans, especially given that there has been a lack of evolutionary pressure for chimpanzees to develop such nuanced social perceptions of humans, a species that has been relatively distant from the chimpanzee until recently. However, there *is* a nonhuman animal species that has had significantly more evolutionary pressure to adapt to the social world of humans: *Canis familiaris*, the domestic dog.

We turned to the domestic dog because we believe that dogs may be a nonhuman animal that carries the unique capacity to gauge competence in humans. In fact, in direct response to research in nonhuman primates, multiple studies have displayed dogs' abilities to better socially interact with humans (Bräuer, Kaminski, Riedel, Call, & Tomasello, 2006; Hare, Brown, Williamson, & Tomasello, 2002). Over the course of domestication, humans actively selected for dogs that were proficient in certain tasks like guarding, hunting, or retrieving food (Coppinger & Coppinger, 2001). This artificial selection allowed dogs to develop unique social sensitivity towards humans that allow them to interact closely with their owners. For example, when faced with an impossible task, dogs look back at their owner, whereas wolves (a close evolutionary relative) do not (Miklósi, Kubinyi, Topál, Gásci, Virányi, & Csányi, 2003), implying that the domestication of dogs has increased their dependency on humans. Additionally, dogs have developed an understanding of human social cues (e.g., pointing (Soproni, Miklósi, Topál, & Csányi, 2002), human facial expressions (Nagasawa, Murai, Mogi, & Kikusui, 2011), and human gaze (Schwab & Huber, 2006)). It is likely that the animals that live primarily in the human home and interact with humans on a daily intimate basis would also hold competence as a social measure (Cooper, Ashton, Bishop, West, Mills, & Young, 2003). If competence is such a salient social characteristic in human eyes, dogs should also be able to encode competence as a way to categorize humans by using the same cues that humans use for each other.

Although no work to date has tested whether dogs judge humans based on their competence, there is evidence that dogs judge humans based on other social factors. Past studies have revealed that dogs prefer a nice experimenter over one who ignores them (Nitzschner, Melis, Kaminski, & Tomasello, 2012), a human experimenter who is cooperative in a task over one who actively deceives them (Petter, Musolino, Roberts, & Cole, 2009), and a generous experimenter over a selfish one (Carballo, Freidin, Putrino, Shimabukuro, Casanave, & Bentosela, 2015; Kundey, De Los Reyes, Royer, Molina, Monnier, German, & Coshun, 2011). Dogs also track the reliability of a human experimenter’s pointing gestures for accuracy and are less inclined to approach an unreliable experimenter (Takaoka, Maeda, Hori, & Fujita, 2015). Additionally, dogs use information more often from a knowledgeable experimenter over an ignorant one (Maginnity & Grace, 2014). These studies show that dogs make judgments about other aspects of a human’s social behavior, raising the possibility that dogs may also understand human competence.

There is also evidence that dogs can track the specific task that humans are able to do. For example, recent work suggests that dogs can track a person’s assigned task. Horn and colleagues (2012) presented dogs with two experimenters, one that loaded an empty apparatus with a reward and the other unblocking the apparatus so that the dog could reach the reward. When presented with either an empty or blocked apparatus, dogs would preferentially look towards the experimenter who could fill or unblock it, respectively, suggesting that they tracked which of two experimenters had relevant skills for a particular problem (Horn, Virányi, Miklósi, Huber, & Range, 2012).

Although there is some work showing that dogs evaluate others based on a variety of social factors, there is still little work addressing whether canines perceive and judge others based on their competence. As a result, the purpose of the current experiment is to test whether domestic dogs, like humans, prefer individuals who are more competent. In this study, we will present dogs with two experimenters, one who is competent in a food-obtaining task and another who is incompetent in this task, and allow dogs to approach one of the experimenters. If dogs tend to approach the competent experimenter more often, then we can conclude that they encode competence as a salient social characteristic in humans and develop preferences using judgments of competence. If dogs do not approach the competent experimenter more often, then understanding competence may not be a skill acquired through domestication, or other social information may take precedence in the development of a preference towards one human over another.

Experiment 1

Method

Participants. We tested a total of 40 dogs (18 male, $M_{age} = 5.75$, $SD_{\text{age}} = 3.404$), see Table 1 for details about age and breed. All dog subjects were household pets whose human companions volunteered their participation through an online system. To be eligible for testing, dogs were required to show no aggressive tendencies, be up to date on vaccinations, and be older than 6 months of age. Prior to participation, dogs had visited the center any number between one and five times to become familiar with the center. Dogs and their companions were given certificates and diplomas as compensation for their time and efforts.

Experiment Procedure. Dogs were tested in a large familiar testing room (3.5m x 3.15 m) within the center. Upon entering the room, the dog's companion was instructed to place their dog on a 260 cm leash attached to the corner of the room, to sit in a chair placed in a corner, and to have their dog sit comfortably in front of them (see Figure 1 for setup). All dogs then participated in a set of routine *warm-up trials* to acclimate them to the center. Each dog received three warm-up trials that consisted of (1) obtaining a food reward off of a plate, (2) obtaining a food reward from an empty bucket (18cm in diameter x 23 cm height for larger dogs; 10cm in diameter x 16cm height for smaller dogs), and (3) obtaining a food reward from a plastic Tupperware container filled with paper shredding. We used 1cm^3 Natural Balance Beef sausage cubes for the food rewards in this experiment, unless the dog had allergies or aversion to the sausage, in which case we used similarly sized treats provided to us by the dog's companion. All subjects successfully completed these warm-up trials.

Dogs then continued onto the experimental testing. Three experimenters ran each trial. The first two male experimenters (*competent* and *incompetent*) entered the room carrying a foldable table (180cm x 76cm x 73cm) and a set of stools. They placed the table 200 cm away from the dog and then sat in stools facing each other on either side of the table. A female third experimenter, the *presenter*, then entered the room and placed two clear Tupperware containers filled with paper shredding on the table. The presenter then instructed the owner to hold the dog close until she dropped her head, the signal to release the dog. After clarifying these instructions, the presenter called the dog's name and tilted the containers to show that they were identical to the containers used in the third warm-up. She then began the Competence/Incompetence demonstrations; the order of these two demonstrations was counterbalanced across subjects.

Competence Demonstration. The presenter called the dog's name, showed the dog and the competent experimenter a food reward, and then dropped it into the competent experimenter's container. The competent experimenter immediately began searching through the container for five seconds before finding the reward. Once he found the reward, he held the reward in his hand, and lowered his hand to the side such that the dog could approach the reward without directly ostensively cueing the dog to approach. The presenter then dropped her head to signal the owner to release the dog. After the dog approached and ate the competent experimenter's reward, the companion was instructed to pull the dog back.

Incompetence Demonstration. The presenter called the dog's name, showed a reward to the incompetent experimenter and the dog, and then dropped the reward into the incompetent experimenter's container. The incompetent experimenter immediately began searching through the container for ten seconds, but ultimately failed to find the reward. The presenter then retrieved the reward herself, showed the dog that she had obtained the reward, and then handed the reward to the incompetent experimenter, who then lowered the reward in the same way as the competent experimenter had during the Competence demonstration. The presenter then dropped her head to signal the owner to release the dog. After the dog approached and ate the incompetent experimenter's reward, the companion was instructed to pull the dog back.

Each dog saw the competence/incompetence demonstrations twice in an ABAB order before moving on to the choice. The individual experimenter who played the competent experimenter (MB or JL), the side of the experimenters (Left or Right), and the order of demonstration (1st or 2nd) were counterbalanced across dogs.

First Choice. After witnessing each of the two demonstrations twice, subjects moved onto the choice phase. The goal of the choice phase was to determine which experimenter (competent or incompetent) the dog preferred after their respective demonstrations. During the choice phase, the presenter called the dog's name, and showed two rewards to the dog and each of the other experimenters before dropping one in each of the containers simultaneously. She then walked out of the room and closed the door behind her. When the door closed, both competent and incompetent experimenters began searching for the reward and the companion released the dog to freely roam around the room and/or approach the experimenters. Both experimenters continued to search for the reward for the next 60 seconds until the presenter re-entered the room. Dog participants never received a food reward in this first choice phase. We hypothesized that dogs would approach the competent experimenter first and spend more time on the competent experimenter's side during the minute-long period. The presenter then instructed the companion to pull the dog back.

Second Choice. The first choice phase did not allow for the dog to actually accept a reward from one of the two experimenters, so we created a second choice so that we could observe how dogs behave if both experimenters presented rewards directly. In this second choice trial, the presenter retrieved both of the rewards from the containers and handed the rewards simultaneously to the competent and incompetent experimenters. The two experimenters lowered their rewards at the same pace, and the presenter dropped her head to signal to the dog's companion that it was time to release the dog. Dogs were then allowed to approach either experimenter and eat his reward. We again predicted that dogs would prefer the competent experimenter, and thus would approach the competent experimenter over the incompetent.

Coding and Analysis. Four variables were fully coded by a coder blind to condition: 1) *initial approach*, 2) *looking-time*, 3) *side preference*, and 4) *rewarded approach.* The *initial approach* was defined as the experimenter the dog first approached in the first choice phase. For coding purposes, a black "V" was taped on the floor such that the open end of the "V" faced the dog. A third line extended from the point of the "V" to the center of the table, such that the line was perpendicular to the long edge of the table. Overall, the final taped structure resembled an uppercase "Y". We defined an initial approach as the side of the "V" that the dog initially crossed with both front paws to approach an experimenter. Eight dogs were excluded from this variable analysis because they did not approach either experimenter during the 60-second interval. *Looking-time* was defined as the amount of time that the subject looked at the experimenter or his container, regardless of the dog's physical location, for the first 30 seconds of the first choice phase[1]. *Side preference* was defined as the amount of time the dog's front paws spent across one side of the "V" during the first 30-second interval. In cases in which dogs had one paw on each side of the V, no preference was recorded. Finally, the *rewarded approach* was the first experimenter approached in the second choice phase; we measured this approach identically to the *initial approach* in the First Choice phase. All variables were analyzed with SPSS software.

Results.

We first tested whether dogs showed a preference for the competent experimenter during the initial approach. A binomial probability revealed that dogs showed no preference towards the competent experimenter (N = 17) or the incompetent experimenter (N = 15), Binomial

[1] We chose to use only a 30-second interval since many dogs lost interest in the choice phase after that time period, with many going back to their companions or simply lying down next to an experimenter.

Probability: 53.1%, *p* (two-tailed) = 0.701. The remainder of the dogs (N = 8) were excluded from the analysis because they did not approach either experimenter for the initial approach. We then tested whether dogs showed a preference for the competent experimenter based on our looking time measure. We found no significant difference between the amount of time that dogs looked at the competent experimenter (M = 9.333 seconds, SD = 7.425) and the incompetent experimenter (M = 11.204 s, SD = 7.043), $t(39) = -0.766$, Paired *t*-test: p = 0.368. We then tested whether dogs showed a side preference during the initial choice phase; this analysis revealed no significant difference between the side preference of dogs towards the competent experimenter (M = 9.820 s, SD = 10.371) and the incompetent experimenter (M = 9.28 s, SD = 10.334), $t(39)$ = 0.195, Paired *t*-test: $p = 0.847$. Finally, we tested whether dogs approached one experimenter more often in the rewarded approach. This analysis revealed no difference in dogs' approach towards the competent experimenter (N = 20) and the incompetent experimenter (N = 20) more often than the other, Binomial Probability: 50%, *p* (two-tailed) = 1.00. Interestingly, for only this measure, an independent samples *t*-test revealed that dogs preferred the left side (N = 30) significantly more than the right side (N = 10), Binomial Probability: 75.0%, *p* (two-tailed) < .01.

Discussion

In Experiment 1, we hypothesized that dogs would initially approach, look at, and spend more time with a competent experimenter who reliably helped them obtain a food reward than an incompetent experimenter who failed to help. We found that dogs showed no preference for the competent experimenter. None of our measures (first approach, looking time, side preference, and rewarded approach) showed a significant preference for either experimenter. Indeed, many dogs continued to approach the incompetent experimenter, who demonstrated multiple times that he was unable to retrieve the food reward on his own.

Our results hint that dogs may not automatically perceive the competence of another individual in the same way that humans do. However, another possible explanation for this pattern of performance is that our competence demonstrations may have been too complicated, nuanced, or long for dogs to understand and process. To distinguish between these possibilities, Experiment 2 tested dogs in a control condition in order to ensure that dogs understood the experimental protocol by itself without the distraction of competence/incompetence, determining if dogs were able to discriminate between the two experimenters on our dependent measures based on the salient criteria. In this new able/unable control, we made the difference between the two experimenters more salient by never allowing one experimenter to touch a food reward during the entire study. If dogs show a clear preference for the experimenter with food on our four dependent measures in this new experiment, we can conclude that the methodology we used in Experiment 1 must be sound and dogs failed to show a preference specifically because they lack the understanding of competence. However, if dogs also failed to recognize a difference between the two experimenters in this new able/unable control condition, then we could instead conclude that our dependent measures are insufficient to tap into dogs' preferences in order to examine competence perception.

Experiment 2

Method

Participants. We tested a total of 20 dogs (10 male, $M_{\text{age}} = 4.700$, $SD_{\text{age}} = 2.903$) recruited from the same pool as that of Experiment 1 in July 2015. No dogs had previously been tested in Experiment 1. We planned to test fewer dogs in this control condition because we expected this task to be more straightforward for dogs to understand than Experiment 1, so we expected a stronger effect size in Experiment 2.

Experiment Procedure. The experimental setup and warmup were identical to those of Experiment 1, as were the two experimenters (MB and JL) and the presenter KM. After dogs completed the warm-up trials, they then moved onto the experimental testing with Able and Unable demonstrations; the order of these two demonstrations was counterbalanced across subjects.

Able Demonstration. The Able demonstration was identical to that of the Competence Demonstration in Experiment 1.

Unable Demonstration. We designed the Unable demonstration to be similar to the Incompetence demonstration from Experiment 1, but we removed any possibility that the unable experimenter could obtain the food reward; the unable experimenter therefore fails to find the food not because he is incompetent but because there is never food to be found. The presenter began the Unable demonstration by calling the dog's name. She then showed a reward to the dog and the unable experimenter, but then placed the reward back into the pouch. In this way, no food reward was available to be found inside the searching box. She then turned to face the unable experimenter, who began searching in vain for 10 seconds before giving up on the task. The presenter then leaned over the unable experimenter's side and gave the dog a reward. As a result, the unable experimenter was never in contact with a food reward, though the dog received rewards equally from both sides of the table.

First Choice. The choice phase of Experiment 2 was similar to that of Experiment 1 except that no reward was placed in the unable experimenter's container. The presenter called the dog's name, holding a single reward on the able experimenter's side while holding an open empty palm upwards on the unable experimenter's side. She then lowered her hands over each of the containers, dropping the reward in the able experimenter's container, and then leaving the room. The able and unable experimenters began searching for 60 seconds immediately after the door closed and the dog was allowed to approach and roam around the room. We predicted that dogs would initially approach the able experimenter and spend more time on the able experimenter's side. After 60 seconds, the third experimenter re-entered the room and instructed the companion to pull the dog back.

Second Choice. The presenter retrieved the reward from the able experimenter's container and handed it to him. She also pretended to retrieve the reward from the unable experimenter, but visibly to the dog gave him nothing. The able and unable experimenters then lowered their hands simultaneously and the dog was allowed to approach when the presenter dropped her head. We predicted that dogs would approach the able experimenter, as he was the only experimenter with a reward.

Coding and Analysis. The same four variables were coded as those in Experiment 1. Four dogs were excluded from the initial approach variable analysis because they did not approach either experimenter during the 60-second interval.

Results.

We first measured dogs' initial approach in Experiment 2; this analysis revealed that dogs approached the able experimenter ($N = 15$) significantly more often than they approached the unable experimenter ($N = 1$), Binomial Probability: 93.7%, p (two-tailed) < 0.001. We then used a paired t-test to determine whether dogs looked at the able experimenter more than the unable experimenter during the 30-second interval. This analysis revealed that dogs looked significantly more towards the able experimenter ($M = 15.648$ seconds, $SD = 6.776$) than the unable experimenter (*M* = 4.878 s, *SD* = 3.700), $t(19) = 5.239$, $p < 0.001$. We then tested whether dogs preferred one experimenter's side over the other's during the 30-second interval. This paired *t*-test revealed that dogs showed a non-significant trend towards the able experimenter's side (*M* = 12.665 s, *SD* = 11.804) over the unable experimenter's side (*M* = 5.608 s, *SD* = 8.722), $t(19) = 1.841$, $p = 0.081$. Finally, our rewarded choice measure revealed that dogs did not approach the able experimenter (N = 10) significantly more than the unable experimenter (N = 10), Binomial Probability: 50%, $p = 1$; instead, dogs appeared to approach the left side (N = 14) more than the right side (N = 6), Binomial Probability: 84.0%, $p = 0.096$, as though they had a side bias.

Discussion.

The objective of Experiment 2 was to see if dogs would form a preference on our dependent measures when a more salient difference between the two experimenters was introduced. We stripped the food reward from the incompetent experimenter in all portions of the study to create an unable experimenter. As a result, even if dogs did not understand competence, they should still discriminate between the two experimenters. The results of Experiment 2 revealed that dogs significantly preferred the able experimenter across two of our four dependent measures; dogs preferred the able experimenter over the unable experimenter both in terms of their initial approach and their looking time, implying that dogs actively expected the able experimenter to give a reward before he presented it to the dog. The non-significant third measure (side preference) showed that dogs were actively spending more time next to the able experimenter in expectation for the food reward. In our fourth measure, dogs once again did not seem to discriminate between the two experimenters. We assume that this measure is not valid, as dogs observed that the able experimenter did not retrieve the food reward during the sixty-second choice phase, so any previous perceptions of the able experimenter were washed out.

Taken together, these three measures are good indicators that dogs are preferring the able experimenter. Thus, we can conclude that these three measures are adequate measures for exploring dogs' social preferences.

General Discussion.

The goal of our experiments was to test whether dogs preferred to interact with a competent over an incompetent experimenter. We hypothesized that dogs would rather approach an experimenter who has demonstrated competence in a reward-retrieving task over an incompetent one. However, across four different measures of preference, Experiment 1 found that dogs did not prefer to approach or look at the competent experimenter more than the incompetent, implying that dogs did not develop a social preference for either experimenter. The results of Experiment 2 showed that the failure to find a preference in Experiment 1 was not merely due to the nuances of the methodology; rather, dogs in Experiment 2 actively showed a preference for an able experimenter over an unable one, suggesting that the setup we used is sufficient for observing when dogs have a preference for one human over another. Though we initially hypothesized that a simple perception of human competence would be intuitive for dogs, our findings indicate that dogs do not discriminate between competent and incompetent human experimenters.

There are multiple possibilities for this behavior in Experiment 1. One explanation for the behavior is that dogs were sometimes attracted to the incompetent experimenter to investigate his lack of competence or to attempt to steal his reward. This was evidenced when some dogs attempted to climb up the table or the incompetent experimenter's leg to retrieve the reward for themselves (N = 5). However, Experiment 2 demonstrates that without the distracting factor of a food reward in the unable experimenter's plastic container, dogs do not wish to investigate the experimenter for novel reasons outside of the reward, revealing the shortcomings of this explanation. We can conclude that though dogs can track which human can present them with food rewards (as seen in Experiment 2), they are not necessarily attributing competence as a social characteristic to the individual.

Another possibility is that dogs do not register human competence at all, so they approach both experimenters at chance. It is possible that dogs do not encode competence because it is not relevant to them. The majority of our canine participants come from small households, so it may be possible that a dog does not need to rank the competencies of their companion(s) on a frequent basis. It is thus possible that dogs who interact with greater numbers of humans would be able to assess different strangers' competencies better than the population of dogs we tested in this study. Another possibility is that linguistic ability is required to understand competence. Although dogs can distinguish between certain commands and names of objects (Kaminski, Call, & Fischer, 2004), there is no evidence indicating that dogs can comprehend full sentences or complex phrases. The ability to specifically ideate certain traits or behaviors with words has been shown to be a critical factor in creating correlations between unrelated motions (e.g. putting a book on a desk vs. putting a ring on a finger) and distinguishing between nuanced concepts like loose-fitting and tight-fitting (Hespos & Spelke, 2004). Perhaps language is an important component of distinguishing competence from incompetence in humans, given that language is used to cognitively embrace and wrestle with more nuanced topics. Perhaps competence is a concept that requires linguistic footholds because it contains multiple components and may not be as evolutionarily salient of a social aspect to focus on. Or perhaps language is required to actively articulate competence from other social traits (e.g. generosity, deceitfulness) that can affect a dog's judgment of humans.

Another possibility is that dogs *do* register that some humans are more competent at a task than others, but that information does not significantly affect their preferences for these humans. For example, dog's choices in experimenter were perhaps driven by other emotions like pity or compassion. It is possible that dogs were drawn to the incompetent experimenter to soothe the experimenter's "distress" or to further investigate why he was unable to perform a simple task. Especially given that some of our participants were trained to be therapy or service dogs (N = 10 reported), it is possible that some dogs may have ignored their impulse to approach a food reward in the desire to assist with the task or give emotional support. Fiske et al. (2007) explicitly mentions how competence is not always a positive trait in humans' social evaluations; rather, a combination assessment of competence and warmth is required to fully judge someone else. As a result, even if competence is encoded, dogs would not find this information sufficient to create a significant preference for one human over another.

One methodological limitation that we encountered in this study was the large side preference in the rewarded choice phase. We ran the rewarded choice because we did not previously test how dogs would approach if *both* experimenters presented a food reward simultaneously. We expected that dogs would have a lingering preference for the competent experimenter after the demonstrations, but we instead saw a significant side bias towards the dog's left side. A combination of factors, including the time delay between competence/incompetence demonstrations and the fact that the competent/able experimenter did not retrieve the reward during this sixty-second period, explains why dogs did not develop a preference for either experimenter. The side preference has been observed in other studies with canines (Nitzschner, Kaminski, Melis, & Tomasello, 2014), and it may require a change in the creation of a new experimental paradigm that does not place two experimenters side-by-side to investigate social preferences.

We hope that these experiments will open up discussion in the field of comparative cognition to examine the idea of competence on a more rigorous level. At the very least, our experiments give an example of a working methodology that can be translated to testing competence in other animals and human infants. Whether exploring different types of competence or how competence can be related to other salient social characteristics, the dearth of empirical studies approaching competence does not match its significance within the human psyche. Though dogs may not understand competence in the form of a fine motor task, there are many other directions to take this method (e.g. social or physical competence) that can reveal the evolutionary and environmental roots crucial for understanding how perception of competence emerges in humans today.

Conclusion.

Although humans automatically encode competence as a social characteristic when meeting another human, our results indicate that dogs do not use competence as an evaluative social measure. This indicates that competence may be a more sophisticated criterion that was not realized by dogs even after millennia of domestication and artificial selection by humans, unlike other traits like kindness or knowledgeability. Humans' fundamental capacity to make judgments based on competence is reflected by chimpanzees' ability to recruit better collaborators (Melis et al., 2006), implying that an aspect of living as primates may have created the need to more actively assess competence. One specific interpretation of these results is that dogs do not encode competence because they do not have enough experience with other humans besides their companions. Competence is inherently a comparative trait, as one person's competence is directly based off of another's. Perhaps one prerequisite for social evaluations based on competence is exposure to a large number of other individuals. As a result, humans have this capability to judge others based on their competence because they are consistently comparing individuals with others. Meanwhile, dogs live in a concentrated social vacuum, rarely interacting with people outside of their home, so they have no development of these faculties to compare two novel humans' respective competencies. If this is the case, the evaluations that humans make surrounding competence are based off of experiences with other people, which makes competence a more variable trait between individuals and allows for humans to evaluate the same person in very different ways. A large question in social cognition is how our social evaluations of others affect our behaviors towards them, and this study reveals how the capacity to assess one specific trait – competence – is based off of one's social experience. When paired with previous models presented by Fiske et al. (2007), these results inform us that people's attitudes towards others are highly dependent on their previous experience with other humans, implying that social experience is required for humans to automatically form judgments of others based on competence.

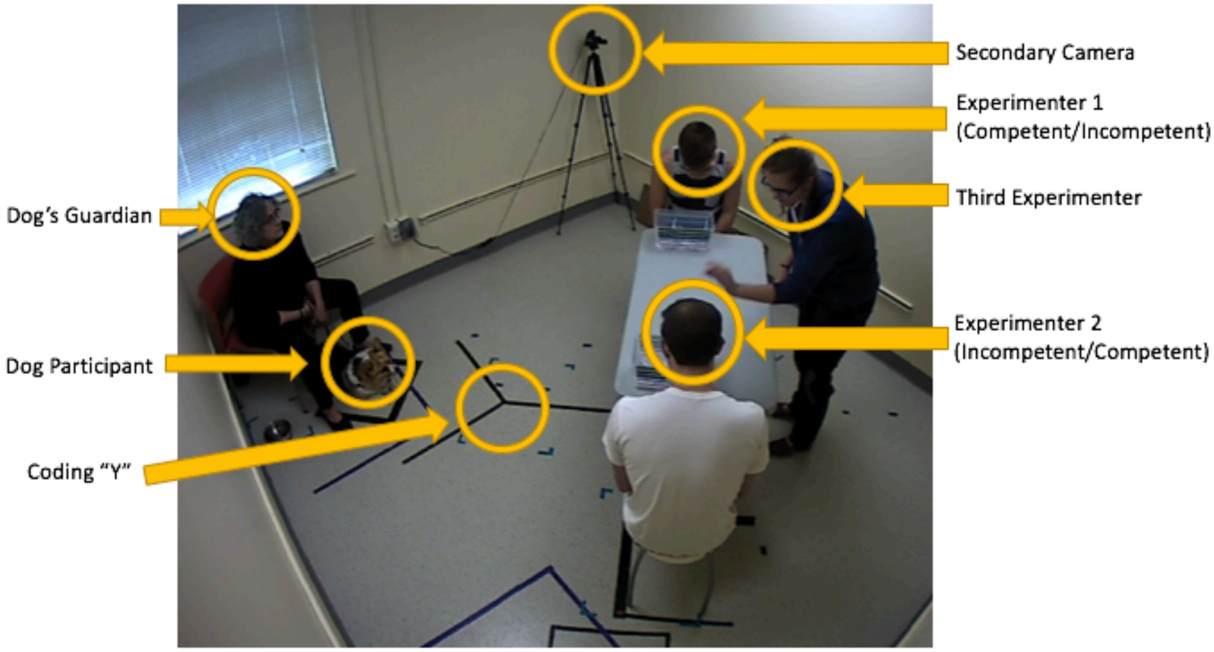

Figure 1. Still of the experiment room layout

Name	Species/Breed	Sex	Age	Experiment
Abby	Lab/Beagle/Pitt Mix	F	9	Experiment 1
Bentley	Lhasa Apso/Poodle Mix	M	7	Experiment 1
Bosco	French Bulldog	M	3	Experiment 1
Buster	Hound Mix	M	1	Experiment 1
Charlie	English Setter	M	1	Experiment 1
Chelsea	Australian Shepherd	F	5	Experiment 1
Coco M.	Maltese/Yorkie Mix	F	3	Experiment 1
Cora	Australian Shepherd	F	3	Experiment 1
Cyrus	German Shepherd	M	8	Experiment 1
Dallas	Cocker Spaniel	F	3	Experiment 1
Denver	Cockapoo	M	10	Experiment 1
Dolly	Pembroke Welsh Corgi	F	10	Experiment 1
Dublin	Labrador Retriever/Rottweiler Mix	M	7	Experiment 1
Duchess	Great Dane/Catahoula Leopard Mix	F	4	Experiment 1
Fable	Bassett Hound	F	3	Experiment 1
Gandalf	Maltese	M	14	Experiment 1
Gobi	Labradoodle	M	2	Experiment 1
Holly	Collie/German Shepherd Mix	F	4	Experiment 1
Isis	Rottweiler/Australian Shepherd Mix	F	4	Experiment 1
Jack	Corgi/Beagle Mix	M	5	Experiment 1
Kali	Terrier/Boxer/Bulldog Mix	F	7	Experiment 1
Kismet	Black Lab/Golden Retriever Mix	F	5	Experiment 1
Lily	Standard Poodle	F	7	Experiment 1

Lincoln	Standard Poodle	M	3	Experiment 1
Maggie D.	Yellow Lab	F	13	Experiment 1
Maggie P.	Schnauzer/Poodle Mix	F	8	Experiment 1
Maggie S.	Dachshund/Spaniel/Border Collie Mix	F	5	Experiment 1
Maxine	Pit Bull/Jack Terrier/Beagle Mix	F	7	Experiment 1
Monty	Terrier Mix	M	2	Experiment 1
Oscar	Shiba Inu	M	2	Experiment 1
Ovie	Border Collie/Miniature Poodle Mix	M	2	Experiment 1
Papa	Pug/Beagle Mix	M	4	Experiment 1
Peeves	German Shepherd	M	7	Experiment 1
Penn	Labradoodle	M	6	Experiment 1
Pietrus	Golden Retriever/Bernese Mountain Dog/Chow Chow Mix	M	5	Experiment 1
Piper	Scottish Terrier	F	3	Experiment 1
Sadie Ca.	Yorkie/Toy Poodle Mix	F	6	Experiment 1
Sissy	Yorkshire Terrier	F	12	Experiment 1
Yeshe	Cockapoo	F	14	Experiment 1
Zoey	Terrier	F	6	Experiment 1
Bee	Border Collie	F	2	Experiment 2
Bodhi	Poodle	M	2	Experiment 2
Bullwinkle	Labrador Retriever/Shepherd Mix	M	3	Experiment 2
Coco B.	Goldendoodle	F	1	Experiment 2
Cooper	Labrador Retriever	M	3	Experiment 2
Edie	Beagle/Coon Hound	F	4	Experiment 2
Gatzby	Great Dane	M	4	Experiment 2
Harley	Beagle/Rottweiler/Hound Mix	M	5	Experiment 2
Kayla	Border Collie/Black Lab Mix	F	5	Experiment 2
Lily	Finnish Spitz/Corgi Mix	F	5	Experiment 2
Ola	Schnauzer/Corgi Mix	F	12	Experiment 2
Perseus	Pekingese/Shih Tzu Mix	M	4	Experiment 2
Peyton	Siberian Husky/Labrador Retriever Mix	F	4	Experiment 2
Rosie	Pembroke Welsh Corgi	F	3	Experiment 2
Sadie Co.	Black Lab Mix	F	2	Experiment 2
Sam	Retriever/Terrier Mix	M	11	Experiment 2
Tiny	Miniature Dachshund	M	8	Experiment 2
Toby	Lab Mix	M	7	Experiment 2
Tucker	Golden Retriever	M	3	Experiment 2
Vivi	Saint Bernard	F	6	Experiment 2

Supplementary Table 1. List of dogs, including species, owner reported breed, and sex (**M**ale/**F**emale), age (in years), and experiment that the subject participated in.

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