2019

"But it's not Fair!": Effects of Experimenter Familiarity on Inequity Aversion in Dogs

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by

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Presented in Partial Fulfillment of the
Requirements of Independent Study Thesis Research

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2018-2019

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Acknowledgements

I would like to thank my advisor, Claudia Thompson, for supporting me through all of I.S. and possibly being even more excited than I was for my project. However, I would also like to thank her for sticking by me for all four years that I've been at Wooster and for teaching me how to further love and appreciate animals, both in my daily life and academically.

Just as importantly, I would like to thank my new friends GusGus, Stella, Bo, Goose, Maverick, Babe, Billie Jean, Erin, Jack, and all of their owners, without whom this I.S. would not have been possible. I had so much fun getting to know all of them, and I hope that one day my four legged friends will be able to forgive me for the terrible treatment they suffered at my hands.

Abstract

Inequity aversion, defined as having a negative reaction to unfair treatment, was considered to be a uniquely human trait for decades but has since been found to exist in a variety of animals, including primates and dogs. Although dogs have been shown to be affected in their decision making based on their familiarity with the humans testing them, this effect had not been previously examined in regard to their responses to inequity aversion. This study aimed to partially replicate the results shown in the first ever study to find inequity aversion in dogs and to further investigate whether their responses were different with a familiar experimenter, their owner, or a stranger. The hypothesis was that dogs would be more tolerant of unequal treatment from their owners and would therefore show fewer negative responses. Eight dogs of various breeds were tested by having a partner and subject sitting next to each other while the experimenter, who varied based on familiarity, asked them to “give paw”. The partner dog was always rewarded whereas the subject dog was either rewarded or not based on the fairness condition. The results showed a significant main effect of fairness on number of commands, signs of stress, and refusals to work. No main effects were found for familiarity, but results were limited by a small sample size and the particular quantification of the dependent measures, Future studies are justified to explore the effects of familiarity on inequity aversion in dogs.

Introduction

By now, it is a fairly accepted notion that, although humans individually may have self-centered interests, we strive to achieve a fair and equitable society. For some, asking what the basis of civilization is, the answer may be that it is this exact need for fairness and justice. Within economics, the models explaining what motivates those selfless or equitable behaviors have been closely studied and theorized. One of these models was named inequity aversion by Fehr and Schmidt (1999), meaning that people have a resistance to inequitable outcomes or even that there is a willingness to relinquish a material pay-off for the sake of achieving a more equitable situation. Specifically, they look at self-centered inequity aversion, in which a person judges the fairness of their outcome in comparison to the outcome of others, as opposed to caring about equity among everyone (Fehr & Schmidt, 1999). Further, it is categorized as either disadvantageous inequity aversion, where one dislikes having a lesser outcome than another, or advantageous inequity aversion, where one dislikes receiving more than another individual.

The concept of disadvantageous and advantageous inequity is illustrated in a study by Blake and McAuliffe (2011), in which children played a game where they could afterward either accept or reject the reward offered to them and another child who served as their partner. Although the six-year-olds only rejected the reward when their partner received more candy than them, eight-year-olds rejected the outcome both when they received less candy than their partner (disadvantageous inequity) and when their partner received less than them (advantageous inequity), showing that both types of inequity aversion develop throughout a child's life. These results are consistent with the findings of economic games with adults (Blake & McAuliffe, 2011).

Inequity Aversion in Primates

Until recently, inequity aversion, and generally a sense of justice, had been considered a uniquely human trait, one of the many characteristics thought to divide us from other non-human animals. However, in the last two decades, the field of animal behavior has exploded with the idea that animals may be inequity averse with the publishing of Brosnan and de Waal's (2003) study with capuchin monkeys. In it, they tested five female capuchin monkeys by putting them in pairs where they could see each other, giving them a token, and asking for it to be given back in return for a reward. In the equality condition, both monkeys received the same low value reward, a cucumber. In the inequality condition, the partner was given a grape, which is a much more valued reward, whereas the subject was still given the cucumber. There were two more conditions: effort control, in which the partner monkey received a grape with no token exchange and the subject exchanged a token in return for a cucumber, and food control, in which there was no partner, but the subject witnessed a grape being placed in the empty area the partner would usually be in, after which again the partner exchanged a token for a cucumber. The experimenters measured latency and rate of the monkeys' successful exchanges as the dependent variable. They found that the number of exchanges changed significantly across conditions in a way that supported the presence of high-value rewards being the cause. The most refusals happened in the effort control condition. Conversely, there was a decrease in refusals in the food control condition, where a partner wasn't present, which indicated the expectation of a high-value reward wasn't based on the presence of the reward, but on a partner receiving it.

A particularly fascinating and compelling occurrence in Brosnan and de Waal's (2003) study was that the monkeys would refuse to hand back the token given to them in some trials. As reported by the experimenters, these refusals had happened on less than 5% of trials in their

previous two years of bartering with these individuals. The progressive increase in refusals during the three non-equity conditions is therefore a marked difference in behavior. Furthermore, in some trials they were recorded not even accepting the reward or refusing to eat it, an even rarer occurrence than the refusal to give back a token. For these reasons, Brosnan and de Waal's (2003) study became one of the first and most compelling cases arguing for the existence of inequity aversion in primates.

Brosnan and de Waal's (2003) results sparked a variety of studies about inequity aversion in primates. Two years after their original study with capuchin monkeys, Brosnan, Schiff, and de Waal (2005) conducted a study about inequity aversion in chimpanzees. Their primary objective was to look at whether chimpanzees will have the same variability in responses to inequity aversion based on differing social relationships. Their hypotheses were that the chimpanzees would display negative reactions to both effort and reward inequity, as well as variability in responses, similar to that of past research with humans, which would be caused by differences in sociality within the tested groups, as well as their length of co-housing. The procedure used was the same token exchange paradigm done by capuchin monkeys (Brosnan & de Waal, 2003). The researchers acknowledged that their very small sample size is a confounding factor in supporting the tested variables as causative ones. Nevertheless, they found that inequity conditions yielded more refusals to exchange their token compared to the equity condition. Additionally, the chimpanzees that had been in a long-term housing situation together almost never refused to complete the exchange, regardless of the equity condition, whereas individuals in shorter-term relationship and pair-housing did, affirming the prediction that social and housing conditions have an effect on responses to inequity aversion. However, gender, dominance rank, and effort were not shown to have any impact. As shown by these results, primates may be very susceptible

to their social relationships when tested for inequity aversion and hence relationship to the partner is a salient variable that should be controlled for as individuals with long-term bonds may obscure the results.

Brosnan et al.'s (2005) study seems like strong evidence for the case of primates being averse to inequity, but following studies struggled to replicate their results. In fact, one such study found opposite reactions in chimpanzees (Bräuer, Call, & Tomasello, 2006). Based on criticisms of Brosnan et al.'s (2005) findings, a study testing a variety of apes (bonobos, orangutans, gorillas, and chimpanzees, total N=30) was conducted by Bräuer et al. (2006). They wanted to confront the criticism that the reactions of the chimpanzees can be explained by the expectation they had of receiving higher quality food, because it was moved in their presence, rather than inequity aversion. To address this criticism, they modified the procedure so that pairs of animals received food of different value, but without having to complete a token exchange task for it. Additional goals of their study were to examine social factors and their influence, as well as whether inequity aversion would be shown by the bonobos, gorillas, and orangutans. To test the objectives, each individual was placed in a different social condition, either with or without a partner in the cage next to them, and a different reward condition, in which they always received the low value reward and a high value reward was given to the partner, or simply dropped into the adjacent cage (based on social condition).

As there was no task given to the apes, the dependent variable used to directly compare to those of Brosnan et al. (2005) was the number of times the individual refused the food, meaning they did not touch it at all. They found that the least food refusals occurred when a partner received a higher value reward than the subject and that subjects begged for food more when a partner was present, particularly the chimpanzees, if the partner received the food they preferred.

This result is in direct opposition to what was found in the study by Brosnan et al. (2005), as their chimpanzees refused food the least number of times when their partner received higher quality food. The researchers interpreted these results to mean that it was indeed simply the expectation of a higher value treat that elicited a negative response in primates and not inequity aversion.

Yet the results found by Bräuer et al. (2006) may be interpreted by alternate explanations that still leave the possibility of inequity aversion open. Long-tailed Macaques were found to display inequity aversion (Massen, Van Den Berg, Spruijt, & Sterck, 2012), in two experiments that examined inequity aversion in relation to amount of effort put into the task and the relationship between the partner and the subject respectively (similarly to Brosnan et al.'s, (2005) study). They tested this by having conditions in which the amount of effort put in varied (termed as different cost-benefit ratios, due to differing reward values) and in which the relationship between the partner and subject varied (either a “friend” or “nonfriend”), as well as dominance level or rank. Opposing their prediction, “friendship” status was not found to have an effect on inequity aversion. However, of note, they found that inequity aversion was expressed only in conditions that required moderate effort, whereas it did not occur in high-effort conditions with low value rewards or when they had to put in no effort for a reward. Based on this finding, the experimenters concluded that effort is indeed a requirement for inequity aversion to occur, which may help explain why Bräuer et al.'s, (2006) apes did not refuse food, even when their partner received the more preferred reward.

Inequity Aversion in Other Animals (in Non-Human and Non-Primate Animals)

Although primates were at first assumed to be the most likely animals to express inequity aversion due to their relation to humans, other animals have been tested for inequity aversion as

well. Among those tested are rats (Oberliessen et al., 2016), cleaner fish (Raihani, McAuliffe, Brosnan, & Bshary, 2012), and wolves (Essler, Marshall-Pescini, & Range, 2017). Crows and ravens were tested (Wascher & Bugnyar, 2013) in a paradigm that closely resembled Brosnan and de Waal's (2003) experiment with capuchin monkeys. Pairs of crows and corvids completed a token exchange task, with conditions varying based on the quality of the subjects' reward compared to their partners', as well whether they were rewarded at all in the presence of a rewarded partner bird. As with the capuchin monkeys, the birds refused to accept the food more frequently in the quality inequity condition than in the equity one. Furthermore, their token exchange performance decreased in the inequity condition, and mostly so when their partner received a reward as a "gift" with no effort, whereas they had to perform a token exchange for the reward. This last finding was regarded as particularly important as it serves as an argument against the criticism that many of the negative responses in inequity studies can be explained by a frustration effect, in which the subject is upset at receiving a low value reward after having received a high value reward. This was the first study to investigate evidence of inequity aversion in birds and, as demonstrated by the results, provides strong support to ravens and crows being inequity averse.

Nevertheless, the results of the previous study cannot be automatically generalized to all birds, as some have not been found to be inequity averse. A study was conducted with kea birds (Heaney, Gray, & Taylor, 2017), in which the experimenters used the token exchange paradigm and conditions that tested reward quality inequity, no reward inequity, and several control conditions. They found no inequity aversion responses in conditions where the quality of the subject birds' reward was lower than that of the partner bird, nor in any conditions in which the subject received a reward. They did find significant differences between the baseline equity

condition and the no reward condition in which the subject was not rewarded for a token exchange after the partner had been rewarded. However, when they compared the no reward condition to that of a non-social no reward condition (where there was no partner, but food was moved to the empty space to control for food movement), they found no difference in the number of successful exchanges. The lack of difference between the two no reward conditions led experimenters to conclude that the decrease in performance wasn't due to inequity aversion, but rather to the frustration effect, as previously mentioned in Wascher and Bugnyar's (2013) study. The overall lack of inequity aversion behavior in keas is theorized to be due to a lack of cooperation in the species. Although kea are highly sociable animals, in captivity they have never been recorded displaying cooperative behaviors, unlike crows and ravens. This lack of cooperation, in fact, may strengthen the claim of inequity aversion existing in some non-human animals, as inequity aversion is thought to have evolved in conjunction with cooperation (Brosnan, 2011).

Theoretical Links of Inequity Aversion and Cooperation

The ultimate function of inequity aversion is not certain, but it has been proposed to be a mechanism that evolved alongside cooperation as a way to maximize cooperation efforts among unrelated individuals and stabilize them (Brosnan, 2011). That cooperation occurs frequently among humans is well known; every day, people work together to achieve various goals, from simple tasks such as washing and drying dishes, to large scale professional projects among coworkers. Indeed, non-human animals share cooperation as a quality as well, although perhaps not quite as commonly. There are countless examples of cooperation among animals. For instance, white-faced monkeys collectively defend their territory from competing groups; meerkats have subordinate females as "helpers" in raising offspring that is not theirs; vampire

bats, that feed on blood, will at times regurgitate blood for bats that are in danger of starvation (Riehl & Frederickson, 2016). Although cooperation may have a direct cost to an individual participating, it is a behavior that is present in a wide number of species and that has lasted over long periods of evolution (Riehl & Frederickson, 2016).

Theoretically, if an individual has the ability to recognize when their partner takes more than their "fair share" of the outcome they both worked toward together, they may choose not to work with the unfair individual anymore (in other words, they are inequity averse). This mechanism thereby increases the individual's personal long-term payoffs, as they may find more equitable partners, and reinforces more equitable behavior in others, as uncooperative individuals have lower fitness (Riehl & Frederickson, 2016). Brosnan (2011) argues that due to these large potential fitness gains, inequity aversion would have been positively selected for and hence is an evolutionary trait.

The relationship between cooperation and inequity aversion is not only theoretical, however; evidence that there is a link has been found in experimental settings as well. In an experiment with capuchin monkeys, subjects were presented with a cooperative barpull task that required participation from both monkeys and that allowed them to decide whether they wanted to participate and which food they were working for (Brosnan, Freeman, & Waal, 2006). Conditions varied based on whether the task was baited equally, with both cups having either a low value reward or high value reward, or unequally, in which one cup was baited with a low value reward and the other was baited with a high value reward. The results showed that it was not the distribution of the rewards that affected whether the task was successfully completed, but whether the partner was dominating the higher value treat in the unequal conditions. These results suggest that cooperation is based in partners treating each other equitably.

Inequity Aversion in Dogs

As a highly cooperative species, it is no surprise that dogs were eventually tested for inequity aversion as well. In place of the token exchange paradigm, a novel task, paw giving, was used in two experiments (Range, Horn, Viranyi, & Huber, 2009). In the first, 29 dogs were made to sit side by side and then asked to give their paw, one after the other, in exchange for a reward. There was an equity condition, in which subject and partner received the same low value reward (white bread, LVR) for giving their paw; quality inequity, in which the subject received a LVR and the partner received a high value reward (sausage, HVR); reward inequity, in which only the partner received a LVR reward for giving its paw; and effort control, in which both received a LVR, but only the subject was required to give its paw prior to it receiving the reward. Additionally, there were two asocial conditions that did not involve a partner: one which served as an assessment condition to see how many times each dog would give its paw for a LVR, and a no reward control, to see how many times it would give its paw for no reward. They found that the only condition which significantly differed from the baseline equity condition, based on the number of trials in which the dogs continued to give the paw, was the reward inequity condition. Of significant note is that this decrease in paw giving did not also occur in the asocial control condition with no partner; because they continued giving their paw in that condition, it cannot be argued that dogs simply experienced frustration at the lack of reward in the reward inequity condition. A present partner then becomes a crucial factor for the inequity aversion response.

To control for the possibility that it was not simply the presence of the partner that explained these results, but a partner receiving food, a follow up experiment was done. They further conducted a second experiment with 14 dogs to test two additional conditions: reward inequity, as previously mentioned, and social control, in which neither partner nor subject dog

received a reward for giving the paw. They found that there was an increase in refusals to give the paw, an increase in hesitation, as well as stress signals in the reward inequity condition. These results were taken as an indication that the dogs hadn't just been responding to the presence of a partner in the previous experiment, but rather to the partner receiving a food when they did not. The results of the two experiments taken together are a strong case for the existence of inequity aversion in dogs.

Some have theorized that the evidence of inequity aversion in dogs is because of having evolved alongside humans, during which they gained specific traits that allow them to cooperate with humans (see McGetrick & Range, 2018). If this hypothesis were true, as opposed to the cooperation one, it would mean wolves would not have a sense of inequity due to a lack of domestication. Essler, Marshall-Pescini, and Range (2017) tested the domestication hypothesis by using a novel task with similarly raised pack dogs and wolves. Additionally, they wanted to explore the reasoning behind dogs not showing quality inequity as do primates, but rather a more primitive form of inequity aversion. They had three posited hypotheses: canines in general only possess a primitive form of quality inequity, in which case wolves would, similarly to dogs, only respond to quality inequity; domestication caused dogs to develop unconditional intraspecific cooperation skills with humans, which would result in wolves still responding to quality inequity, unlike dogs; close socialization between dogs and their human caregivers causes dogs to ignore unfavorable outcomes, hence dogs that were raised in a pack with minimal human contact, as do wolves, will indeed respond to quality inequity.

To test these hypotheses, the experimenters put the dogs and wolves into the same inequity aversion paradigm as past studies, but instead of giving their paw, they were required to press a buzzer using their front paw to receive a reward. All conditions, save for one, were the

same as the first experiment of Range et al.'s (2009) study with dogs; in place of the effort control condition, they used a food control condition, in which both the subject and partner had the high value reward shown to them, but were given the low value reward. The food control condition was utilized in order to control for any frustration effects. They found that there was a significantly lower number of trials that were completed in the reward inequity condition compared to the baseline equity condition. Importantly, and as in Range et al.'s (2009) study, when the reward inequity condition was compared to the no reward condition, the reward inequity condition showed a lower number of completed trials, indicating that it was the presence of another partner receiving food that caused lack of cooperation, and not simply the lack the of reward. In contrast to Range et al.'s (2009) study, there was a significant difference for both wolves and dogs between the equity and the quality inequity conditions.

When number of commands was looked at as the dependent variable as a measure of resistance, more commands were given in the reward inequity condition compared to reward equity, but no difference was found between reward inequity and no reward (which looked at how many times the dog would give its paw with no reward without a partner present). Further, there was an interaction of species with quality inequity: wolves required a higher number of commands than in the equity condition, whereas dogs did not. Rank had an effect as well, as dominant partners completed fewer trials in reward inequity compared to the equity or no reward conditions. Rank and species interacted so that more subordinate dogs showed more signs of distress (but it is unclear whether this was due to working next to a dominant partner-there was no difference between the assessment of how many times a dog would give its paw for a low value reward without a partner and the equity condition). There was also an effect on later interactions based on condition: in quality inequity, dogs took longer to go to the experimenter

and spent less time with them than in the equity condition; dogs that were subordinate to their partner went to the experimenter quicker, regardless of condition; wolves went to the experimenter faster in quality inequity compared to equity, but showed no difference in time spent with the experimenter. An interaction was found between rank and condition in regards to latency to be within one meter of their partner: higher ranking individuals went to their partner faster in the quality inequity condition than in equity. Further, both wolves and dogs spent more time within 1m of their partner in equity than in the quality inequity condition.

The results described above are more similar to that of primates than previously found (Range et al., 2009) in that both dogs and wolves showed inequity aversion to reward inequity, as well as quality inequity. As no dominance effect was found in the control condition, researchers concluded that it is the lack of reward, coupled with the relationship between partner and subject animals, which evokes an inequity aversion response. Furthermore, they conclude that their results support the hypothesis that domestication is not the cause of inequity aversion in dogs, but that the complex social bonds evolved in ancestors. The lack of quality inequity aversion is then attributed to dogs' having a higher tolerance for inequitable outcomes due to their relationship to humans. The finding of subsequent interactions between the subjects and their partner being decreased in the quality inequity condition also supports the cooperation hypothesis: it would be expected that when treated unequally, interactions with unfair individuals would decrease. Although unclear as to why wolves and dogs had opposite reactions to the experimenter in regards to latency to go to and time spent with them, the researchers noted that other research with pet dogs also found that there was greater latency in the subject to go to their experimenter and that they spent less time with them in quality inequity condition compared to equity (Brucks, Essler, Marshall-Pescini, & Range, 2016; as cited by Essler et al., 2017). All in

all, this study strengthened the claim that inequity aversion exists as an evolved trait to facilitate cooperation, rather than as a result of domestication.

However, not all studies of inequity aversion in dogs support its existence. One such study (Horowitz, 2012) employed a completely novel paradigm in which both advantageous and disadvantageous inequity were tested (unlike most others, where only disadvantageous inequity is looked at). A subject and partner dog (total N= 38) were allowed to approach two trainers, one at a time. One trainer rewarded both dogs equally every time for sitting on command and the other either always over-rewarded or always under-rewarded the partner dog. After multiple trials, during which the dogs became familiar with the "fair" and "unfair" trainer, the subject dog alone chose which experimenter to approach. It was expected that, if dogs have a similar sense of equity to that of humans, they would at the very least prefer the fair trainer over the trainer that had over-rewarded their partner, if not even over the one who under-rewarded their partner. The results showed that the dogs went to the over-rewarding trainer a significantly higher number of times than they did the fair trainer, whereas the under-rewarding one was shown the same preference as the fair one.

These results do not mirror those of (Range et al., 2009) and as the dogs preferentially chose the trainer that over-rewarded their partner, Horowitz concluded that dogs do not possess the same sense of "fairness" as do humans. Still, this preference does indeed indicate that dogs are aware of disadvantageous inequity. The explanation posited is that dogs saw the opportunity for a greater reward in the unfair trainer that over-rewarded and hence preferred them. However, if quantity distribution were the primary motivator in dogs' preferences, it would be expected that they would choose the fair trainer more often than the under-rewarding one, which the dogs did not. This finding suggests that the three treats distributed by the over-rewarded trainer

became the only salient characteristic to the dogs, compared to the lesser or no reward. Although the dogs did not show behavior that asked for more fair treatment, this study still exhibits that dogs do have an awareness of unequal outcomes.

It is not only novel paradigms that have failed to find evidence of inequity aversion in dogs, however. Brucks et al. (2017) looked at whether the involvement of the experimenter affected inequity aversion in 44 dogs, using the same buzzer task employed by Essler et al. (2017) in their study with dogs and wolves. They tested equity, quality inequity, and reward inequity conditions with an experimenter visible who distributed awards and with no experimenter visible, in which the rewards were pushed into the enclosures using a stick. They theorized that if the experimenter is absent, dogs may perceive the unequal rewards as based on chance and would display less inequity aversion. Conversely, if they did not perceive it as chance distribution, the lack of an experimenter may offer less of a distraction when observing the partner dog, hence subjects would show more signs of inequity aversion.

Contrary to both of the predictions, the dogs did not react to unequal treatment, regardless of experimenter involvement. However, they did find that in the conditions where the experimenter was present, dogs stopped giving their paw when they were not rewarded and a partner was, but the same rate of refusals was also found in an asocial control condition with no partner and no reward, meaning that the exhibited frustration was based on the expectation of a reward and not on inequity. Further, there was increased gazing at their partner, as well as stress behaviors, in the reward inequity and quality inequity condition when the experimenter was present. The experimenter's hypothesis is that the presence of the experimenter caused the task to be viewed as a more cooperative one, therefore increasing the dogs' sensitivity to their partners' outcome and perhaps indicating an awareness of inequity. Without statistically

significant displays of inequity aversion, the researchers could not decisively conclude that experimenter involvement is a key factor in inequity aversion paradigms, but they took their results as a tentative indication that it was.

In consideration of why there was no inequity response as previously shown in studies with dogs (Range et al., 2009; Brucks et al., 2016), the experimenters suggested that it may be due to the lack of direct interaction with the experimenter (giving paw directly to hand). This lack of direct interaction does not allow for a plausible explanation though, as Essler et al. (2017) lacked this direct contact in their procedure as well, yet still elicited inequity aversion responses. A second posited explanation is that there was also a lack of contact when receiving the reward; they had the rewards slid into the dogs' enclosures in a bowl, rather than giving it directly from a hand, as in paw giving paradigms (Range et al., 2009). This explanation is the more likely one as we do not yet know whether method of reward delivery does indeed have an effect; Essler et al. (2017) differed in this respect, using direct hand rewards after the buzzer was pressed, which may have led the dogs to perceive the task as being more cooperative than in that of Brucks et al. (2017). A lack of perceived cooperation due to the delivery method, compounded by the fact that the rewards were delivered in two separate bowls (rather than one, therefore decreasing competition) may explain the lack of differing responses to inequity. This reasoning highlights the possible importance of cooperation and competition in an inequity aversion paradigm and, just as importantly, illuminates how vital small differences in experimental procedures are.

Alternative Explanations to Inequity Aversion

Many criticisms and debates have been sparked in response to the claim of inequity aversion in non-human animals, which in turn have generated some alternative explanations for the negative responses observed in inequity experiments. Most theories have subsequently been

deemed unlikely based on re-analysis of past data or by future experiments that accounted for the alternative explanations.

One such theory was that the presence of a higher quality reward was what caused the negative responses in capuchin monkeys in the first reported study (Brosnan & de Waal, 2003), rather than the act of their partner receiving the higher quality reward while they did not (Wynne, 2004; as cited by McGetrick & Range, 2018). In the equity conditions, only the low value reward, cucumber, was present, hence there was no reason for the monkeys to react. However, this theory does not hold ground for dogs; in the paw buzzer task by Essler et al. (2017) both types of rewards were present and visible throughout all conditions, fully accounting for this effect.

A more complicated theory is the "food expectation" hypothesis which states that the refusal to keep working stems from the violation of the subject's expectancy to receive a high value treat after watching their partner receive it when they are handed a lower value treat (McGetrick & Range, 2018). The complication in this hypothesis, as explained by McGetrick and Range (2018), is twofold: researchers cannot know what an individual expects, so it is difficult to control for, and it is hard to separate food expectancy from inequity aversion as it very well may be a necessary component of inequity aversion. In fact, socially influenced food expectancy could be the cause of inequity perception, as it may create the expectation that they should receive the same reward exactly because their partner received it. To control for expectation, experimenters have had to isolate what is individual expectation, simply based on what is in the environment, from what is socially facilitated expectation.

According to McGetrick and Range (2018), primate studies have tried to control for individual expectation in a variety of ways, including holding up the intended reward before the

task so that the individual is aware of what to expect or, on the contrary, inducing false expectations (Brosnan, Talbot, Ahlgren, Lambeth, & Schapiro, 2010; Hopper, Lambeth, Schapiro, & Brosnan, 2014; van Wolkenten, Brosnan, & de Waal, 2017). There was some evidence found to support individual expectation, but overall it was shown that despite individual expectation, inequity aversion occurred as well (McGetrick & Range, 2018).

There are also a variety of inequity aversion studies with dogs that do not support the food expectation hypothesis. Range et al.'s (2009) study would have had the same expectation in the inequity condition and the no-reward control condition (subject is not rewarded and does not have partner, but a reward is moved to the place where the partner would usually be). Additionally, both Brucks et al. (2016) and Essler et al. (2017) had food control conditions in which a high value treat was held up after the subject completed the task but was then put back in the bowl and the subject was given a low value reward. These conditions did not elicit negative responses, yet inequity aversion was observed in other conditions. Negative responses to this condition were observed in Brucks et al. (2017); however, inequity aversion was not found at all in their results.

Another presented hypothesis was successive negative contrast, postulated for the refusals in Brosnan and de Waal's (2003) study, which is the lessening in response (instrumental or consummatory) after an individual has experienced an unexpected reduction in the quality or quantity of their reward (McGetrick & Range, 2018). The rationale behind the criticism was that the partner monkeys had received the high value reward (grapes) before being switched to the subject position and receiving the lower value reward (cucumber). Brosnan and de Waal (2003) found no difference in the responses of monkeys who had started as partners first and monkeys that were subjects first (and therefore hadn't experienced the high value reward previously),

hence they rejected the successive negative contrast hypothesis. Range et al. (2009) gave dogs a high value reward before the reward inequity and no reward conditions to control for downshift in reward, as well as always testing those two conditions after they had received rewards in previous ones, thereby ruling out the hypothesis.

Finally, a social disappointment hypothesis has been proposed, which states that negative reactions are not due to animals comparing their payoffs to others but are expressions of disappointment in the experimenter for not rewarding them as well as they could have (Engelmann, Clift, Herrmann, & Tomasello, 2017; as cited by McGetrick & Range, 2018). A study was done to test this hypothesis, in which the equity and inequity conditions also varied on whether a human experimenter or a machine was delivering rewards (Engelmann et al., 2017). They found that there were significantly more refusals to complete the given task in the conditions with a human experimenter and a rewarded partner, compared to the condition with no human, and even more so in a condition with a human experimenter and no partner present. The findings support the social disappointment hypothesis as they indicate that it is not the comparison with the rewarded partner, but the presence of the human that causes the reactions previously interpreted to be inequity aversion.

Nevertheless, McGetrick and Range (2018) argue that social disappointment cannot fully account for the reactions of the dogs in Engelmann et al.'s (2017) study. If social disappointment were a sufficient explanation, then the reactions would have been the same in the no reward condition, where the subject did not have a partner and was not rewarded, and the reward inequity condition, where the subject was not rewarded in the presence of a rewarded partner. However, dogs stopped working earlier in the reward inequity condition, meaning that the presence of a rewarded partner does make a difference. Further, they argue that even though

there is some evidence of social disappointment in social interaction experiments with dogs, it is not contradictory to inequity aversion, but perhaps occurs in conjunction to it.

Other Variables Influencing Inequity Aversion in Dogs

As with primates, other variables influencing inequity aversion in dogs have been studied as well. The influences of relationship, motivation, and attentiveness on inequity aversion were investigated in a series of tests with 22 dogs (Range, Leitner, & Virányi, 2012). Motivation was tested by presenting dogs with an unfamiliar puzzle that presented a problem they could in exchange for food. The persistence of dogs to solve the problem toy was then analyzed to see if higher motivation correlated to less inequity aversion. It was found that motivation did not correlate with the number of times the dog gave its paw in the reward inequity condition, but surprisingly, there was a positive correlation between motivation and the number of times the dog gave its paw in the control condition. When motivation was re-analyzed to see if it correlated with hesitation in the inequity trials, the same results were found. The experimenters suggested that their findings are an indication that motivation may be a modulating variable in the asocial no reward condition, but that performance in reward inequity conditions is linked to other variables.

To test for the effect of attentiveness, the dogs were presented with a problem which could be correctly solved by observing their partner dog (who knew the solution ahead of time) solve it first in a local enhancement task. The predicted relationship between attentiveness and inequity aversion was that more attentive dogs would be more likely to notice inequity during testing, but the researchers found no correlation between attentiveness and the number of times the paw was given in either the reward inequity condition or the control condition. The explanation posited for the lack of a correlation by the researchers was that it is possible that the

focused gaze they measured is not required to pay attention to their partner. It is also possible that dogs simply did not respond to the information given to them, even if they perceived it.

For relationship as an influencing variable, the procedure was more complex, as the relationship was characterized through different methods. In an experimental setting, where the dogs' tolerance for their partner was measured based on the ratio of feed eaten by each dog in the dyad, there was no correlation found with the number of paw raises or amount of compliance with the experimenter. However, the researchers also gathered relationship data through a questionnaire administered to the dogs' owners. Some questions in the questionnaire pertained to the dominance relationship between the two dogs which, as with co-feeding, showed no correlation to inequity aversion in either the control or reward inequity condition. This lack of correlation is in contrast to Essler et al.'s (2017), which did find an effect of dominance rank on inequity aversion in pack dogs, such that more dominant individuals displayed more inequity aversion in the reward inequity condition. The difference in findings may be due to dominance being classified through continuous behavioral observation by the researchers, as opposed to answers given by owners (McGetrick & Range, 2018). Another explanation by McGetrick and Range (2018) is that pack living dogs may form stronger rank divisions than pet dogs, as they experience less human interaction, hence rank was not as salient of a factor for the dogs tested by Essler et al. (2017).

However, the questionnaire additionally asked about the affiliative relationship between the dogs, characterized as the amount of time they spent sleeping in bodily contact with each other. They found that out of 22 dogs, 12 regularly slept in bodily contact with their partner, whereas the other ten never did. It was found that in the quality inequity condition, affiliative relationship was not correlated with the number of times a paw was given, but that dogs with

closer affiliative ties required a significantly higher number of commands given by the experimenter before they complied. There was no effect of affiliation in the control conditions.

These results are indicative of stronger affiliative ties resulting in more inequity aversion in dogs. This is in sharp contrast to the results found with chimpanzees (Brosnan et al., 2005), in which stronger affiliative ties resulted in drastically less displays of inequity aversion. However, as stated by McGetrick and Range (2018), similar results to those with dogs have been found with male marmosets, who only displayed inequity aversion in their pair bonds (Mustoe, Harnisch, Hochfelder, Cavanaugh, & French, 2016); humans, as well, displayed greater aversion to unfair offers from friends, rather than strangers (Wu, Leliveld, & Zhou, 2011). Nevertheless, the results found with Range et al.'s (2012) dogs are lacking in clarity, as it was only number of given commands that was higher and not refusals to give paw, hence further inquiry into the effects of relationship quality between dogs is necessary.

Relationship to Humans as a Variable for Inequity Aversion in Dogs

Although relationship quality between the pair of animals being tested has been extensively studied in primates (Bräuer et al., 2006; Brosnan et al., 2005; Massen et al., 2012) and somewhat in dogs (Essler et al., 2017), the relationship between the subject and the human experimenter has yet to be explicitly studied. Although perhaps not as salient of a factor for most animals, dogs are known to be highly cooperative with humans, exhibiting incredible sensitivity to human gestures and cues, most spending the majority of their lives interacting and being socialized by humans (Horowitz, 2012). It is not then a far stretch to assume that the dogs' relationship to the human distributing rewards may have an effect on their response to inequity aversion.

There has been some investigation into the topic, although it is not extensive. When looking at how experimenter involvement affected inequity aversion yielded no inequity aversion responses, which was contrary to previous findings, Brucks et al. (2017) turned to familiarity of the experimenter as a possible explanation. They theorized that a key difference in their buzzer task compared to that of Essler et al. (2017; which used a buzzer task and indeed did find inequity aversion responses) was that their experimenters were strangers to the dogs, unlike in Essler et al.'s (2017) procedure. To take into account this difference, they conducted a follow up control condition, in which they had the owners of the dogs give the buzzer command and reward the dogs. Despite this control, the results still did not show the dogs reacting to inequity. Thus, no substantial conclusions can be drawn from this study on the effects of familiarity on inequity aversion.

Nevertheless, there is other evidence that humans have an effect on dogs' choices and behaviors. It has been shown that food choice can be influenced by the dogs' owners (Prato-Previde, Marshall-Pescini, & Valsecchi, 2008). When given a choice between smaller or bigger quantities of food, dogs were found to choose the large quantity significantly more than the small quantity, but when previously having seen their owner favor the small quantity, the number of times they chose the large quantity was reduced to those of chance. Although these results don't speak to whether a stranger would influence the dogs' choices to the same degree as their owners, they are indicative of dogs making counterproductive choices for themselves in favor of their owners' "preferences." If replaced with a different counterproductive choice, such as continuing to complete a task even in light of inequity, it is possible that their aversion to the inequity would be slightly more dimmed than it otherwise might be. Further, the dogs in Prato-Previde et al.'s (2008) study were scored based on separation related issues from their owners

and those that scored higher showed a greater inclination to following their owners' misleading preferences. The authors theorized that this inclination is due to a greater dependence on their owners; thus, it could follow that the degree of dependency would be reflected in familiarity and dogs would make more counterproductive choices with more familiar people.

This assertion is made stronger by further investigation into the effects of human familiarity on dogs. A study by Cunningham and Ramos (2014) looked specifically at how familiarity with the cue giver and level of training the dogs had previously experienced affected the dogs' ability to follow cues. Unfamiliar and familiar partners gave orders employing either a gesture or eye movement, or both simultaneously to dogs that varied based on the amount of previous training they'd undergone (shelter dogs, pet dogs, and competitive training dogs). They found that level of training did not have an effect on the dogs' success in following cues, but more importantly to this study, familiarity significantly affected behavior, in that both pet and highly trained dogs interpreted cues more successfully when given by an owner than an unfamiliar person. These results suggest that, taken together with the study by Prato-Previde et al. (2008) on food choice, the more familiar a dog is to a human, the less likely they may be to respond to inequity caused by said human.

Current Study

The current study had two primary objectives. The first one was to partially replicate the results found in Range, Horn, Viranyi, and Huber's (2009) study, in which they found evidence to support that dogs are inequity averse. The current study tested the following two conditions from the original study: equity, in which both dogs are rewarded equally, and inequity, in which only the partner dog is rewarded, the two conditions showing the most consistent findings of inequity aversion in the original study (Range et al., 2009). Based on their findings (Range et al.,

2009), my hypothesis was that the pet dogs would show significantly more negative reactions during the inequity condition compared to the equity condition.

Second, I added a so far completely uninvestigated variable of tester familiarity, meaning each dog was tested in the equity and inequity conditions by an unfamiliar tester (the primary investigator) and a familiar one (their owner) to test for familiarity effects. In past research regarding inequity aversion, familiarity was only studied in relation to affiliation to the partner animal, rather than the experimenter; with primates, it has been found that closer bonds lead to less negative reactions to inequity aversion (Brosnan, Schiff, & de Waal, 2005), whereas with dogs the opposite was found (Range, Leitner, & Virányi, 2012). When familiarity effects of the human have been tested, it has been found that owners can influence dogs to make choices than do not yield the highest benefit to the dog (Prato-Previde et al., 2008) and that greater familiarity of a human leads dogs to reading human cues more successfully.

It is therefore a possibility that the relationship with the tester would have an effect on inequity aversion responses as well; as pointed out by Essler, Marshall-Pescini, and Range (2017), dogs may be more tolerant of unequal treatment from humans due to training and positive interactions throughout their life. Humans they have had more of these positive interactions with may then elicit more tolerance from the dogs, than someone they have had no contact with in the past. Based on this rationale, I predicted that the dogs would have comparatively lower levels of negative reactions during the inequity condition when tested by the familiar tester. In the equity condition, I predicted that there would be no difference in reactions between the familiar and unfamiliar tester conditions.

These hypotheses were tested by using a similar procedure to that of Range et al. (2009): two dogs, sitting side by side, were asked by the tester to give paw one after the other. The

partner dog was always rewarded, whereas the subject dog was rewarded only in the equity condition. The equity and inequity conditions were both tested by a familiar tester (the dogs' owner) and then again by an unfamiliar tester. The order of who tested was varied to counterbalance the conditions. Inequity aversion was measured by the number of times a dog obeyed the "give paw" command, the number of commands given, and signs of distress displayed by the subject dog. Signs of distress included panting, mouth licking, and pacing.

Method

Subjects

Eight dogs of varying age and breed were used in this study, two females and six males. All eight dogs were privately owned pets and had to know to give their paw on command prior to the testing procedure as a prerequisite to participation. All dogs were screened for any aggression in the presence of food or towards other dogs; owners were asked for any previous displays of aggression. Dogs living in the same household were not tested together in order to control for stronger affiliative ties. No food or water deprivation was done; however, owners were asked to not feed their dogs within the two hours prior to testing to control for food satiation.

Dogs were recruited through emailing all staff and faculty of The College of Wooster, speaking to owners of therapy dogs brought to campus, and posting recruitment flyers at the Wayne County Humane Society, Cleveland Road Animal Hospital, and the Cleveland Road Pet Hotel. A power analysis of moderate effect and 80% power indicated that a sample size of 64 dogs was required. As this was not a realistic goal within the time limitations of the current study, the original aim was to test 30 dogs so as to make the results comparable to that of Range et al. (2009) who had a sample size of 29.

Materials

As there was no quality inequity testing, only one type of reward was used: hot dogs cut up into small pieces. Small dogs (less than 20 pounds) received half the size of the hot dog pieces (approximately 80 pieces per hot dog) than larger dogs (40 pieces per hot dog), but all treats were kept in the same container during testing. A metal wire barrier was placed in between two dogs, so that they were able to see each other, but not reach each other. Two leashes of equal length were used to prevent dogs from reaching the tester during the trials. A see-through plastic bowl was used to hold the treats in all trials. Thin workers' gloves were available as an extra protective layer for all persons doing testing. Finally, a Nikon 2500 camera was used to video record each testing trial.

Design

The results from this study were analyzed using a 2 x 2 mixed design. There were two independent variables: *familiarity of tester*, with two levels (*unfamiliar*, the primary investigator, and *familiar*, the dog's owner); and *fairness*, with two levels (*equity*, in which both dogs received the same reward, and *inequity*, where only the partner received the reward after task completion). All subject dogs completed the conditions sequentially, so *fairness* and *familiarity* are within subjects factors. Four dependent variables were measured: number of commands given (maximum of 10 per trial), signs of stress (mouth licking, panting, whining, barking), signs of withdrawal (turning head away from experimenter, backing up, walking away from experimenter), and number of refusals to give paw.

Procedure

All owners were asked to sign a consent form prior to beginning testing. The dogs were tested on college grounds, two at a time. They were brought into a lab space in Morgan Hall Social/Developmental Lab Room, set up as a comfortable, home-like "sitting room." They were placed side by side, with a freestanding metal wire barrier placed between them, in order to prevent the dogs reaching each other in the event of any aggression displays. Their leashes were also secured to a hard point behind them to prevent them from reaching the tester.

Both the inequity and equity condition were tested by the dogs' owner for the familiar tester conditions, whereas a stranger (the primary investigator) administered testing for the unfamiliar tester conditions. The tester sat on a small stool in front of the dogs, facing them. The bowl containing the rewards was placed in the tester's lap so as to be visible to both dogs. This positioning remained constant for both fairness conditions.

Every dog served as both partner and subject for each condition but stayed in their respective role for the whole duration of a testing session. Each testing session consisted of 80 trials, 20 per condition. The equity conditions were always tested first, to avoid frustration that could impair the reactions for the following conditions. The familiar and unfamiliar conditions randomly varied so as to counterbalance the conditions and were conducted exactly the same by both testers. Each condition was followed by a five minute break, during which the partner and subject dog were free to roam around the testing room.

Equity condition. Trials began once both dogs were sitting. The tester first asked the partner dog for their paw by holding out their hand and saying the command "paw." After two seconds, if the dog had not complied, the command was repeated. If the partner dog gave its

paw, it was rewarded with a treat. Immediately following this, the subject dog was asked to give its paw following the exact same procedure of the hand and "paw" command. The subject dog was also rewarded if it complied with the command. Each command was given a maximum of 10 times per trial, after which the trial was terminated if there was still no compliance.

Inequity condition. As with the equity condition, trials began once both dogs were sitting. The tester gave the command to the partner dog first and rewarded it with the treat once it had complied. Immediately following this, the subject dog was asked to give its paw. However, in this condition, the subject dog was not rewarded for complying with the command. Again, each command was given a maximum of 10 times per trial, after which the trial was terminated.

See Appendix A for illustration of the procedure.

All procedures were approved by the Institutional Animal Care and Use Committee at The College of Wooster prior to testing.

Results

The first hypothesis stated that in the two equity conditions, the dogs would not differ on any of the four dependent measures (number of commands given to them, signs of stress, signs of withdrawal, and overall refusals), regardless of familiarity. The second hypothesis predicted that both inequity conditions would score significantly higher on all dependent measures compared to the equity conditions. The third hypothesis was that dogs tested by an unfamiliar person in the inequity condition would score higher on the four dependent measures than when tested by a familiar person. All three hypotheses were tested by conducting four 2x2 within-subjects ANOVAs in SPSS.

Effects of Fairness and Familiarity on Commands

To test the effects of inequity and tester familiarity on the number of commands given to the subject dog, a 2x2 within-subjects ANOVA was conducted. The two independent variables were Fairness, with two levels (Equity and Inequity), and Familiarity, with two levels (Unfamiliar and Familiar). The dependent variable was scored on a discrete scale from one to 10 per trial, with the overall range per condition being between 20 and 200.

Figure 1 illustrates the means and standard deviations of the analysis. The means and standard deviations for each of the conditions were as follows: equity familiar (M= 20.00, SD= .000), equity unfamiliar (M= 20.50, SD= 1.414), inequity familiar (M= 54.88, SD= 40.126), inequity unfamiliar (M= 64.00, SD= 43.857). There was significant main effect for fairness $F(1, 7) = 8.852$, $p = 0.021$ ($\eta^2 = 0.558$), but no main effect for familiarity $F(1, 7) = 0.508$, $p = 0.499$ ($\eta^2 = 0.068$). There was no interaction found between fairness and familiarity $F(1, 7) = 0.431$, $p = 0.532$ ($\eta^2 = 0.558$).

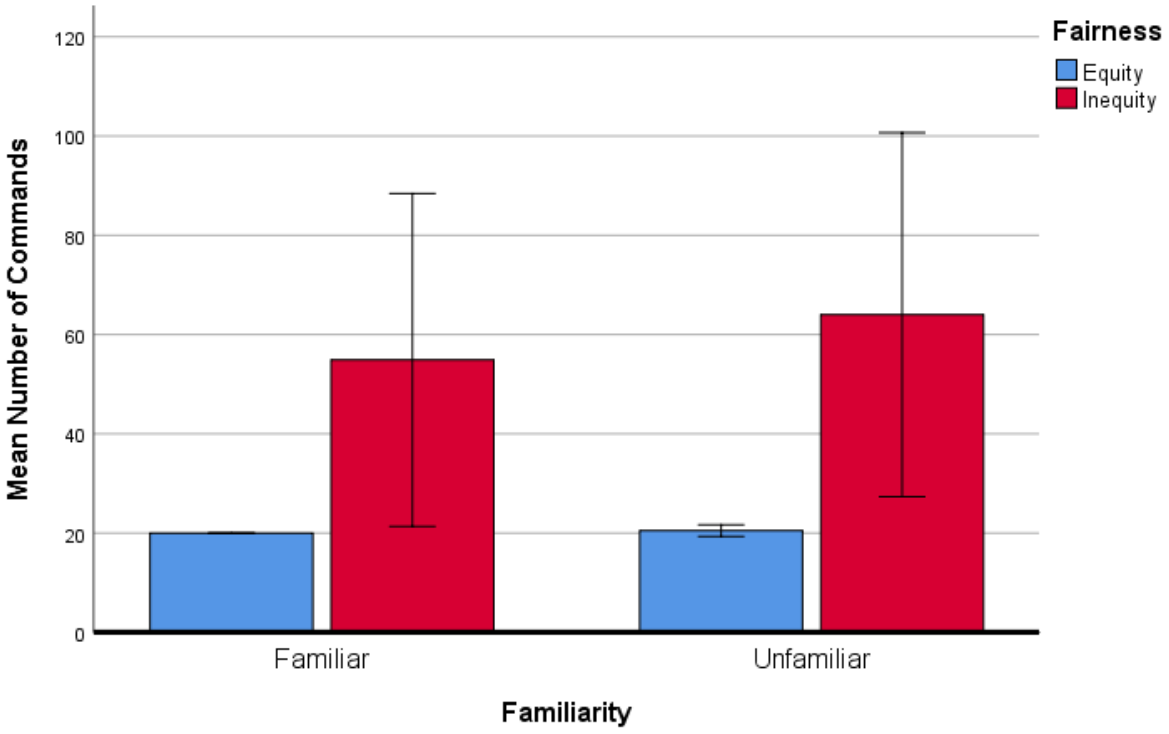

Figure 1. Mean number of commands per condition. This figure shows the mean number of times the tester in the equity familiar (M= 20.00, SD= .000), equity unfamiliar (M= 20.50, SD= 1.414), inequity familiar (M= 54.88, SD= 40.126), inequity unfamiliar (M= 64.00, SD= 43.857) conditions had to give the paw command to have the task completed and the standard deviations.

Effects of Fairness and Familiarity on Stress

To test the effects of inequity and tester familiarity on the amount of stress displayed by the subject dog, a 2x2 within-subjects ANOVA was conducted. The two independent variables were Fairness, with two levels (Equity and Inequity), and Familiarity, with two levels (Unfamiliar and Familiar). The dependent variable was scored on a discrete scale from zero and upwards.

Figure 2 illustrates the means and standard deviations of the analysis. The means and standard deviations for each of the conditions were as follows: equity familiar (M= 6.38, SD= 6.163), equity unfamiliar (M= 7.88, SD= 7.120), inequity familiar (M= 21.63, SD= 9.242), inequity unfamiliar (M= 19.00, SD= 9.212). There was significant main effect for fairness $F(1, 7) = 47.631$, $p = 0.000$ ($\eta^2 = 0.872$), but no main effect for familiarity $F(1, 7) = 0.068$, $p = 0.801$ ($\eta^2 = 0.010$). There was no interaction found between fairness and familiarity $F(1, 7) = 0.958$, $p = 0.360$ ($\eta^2 = 0.120$).

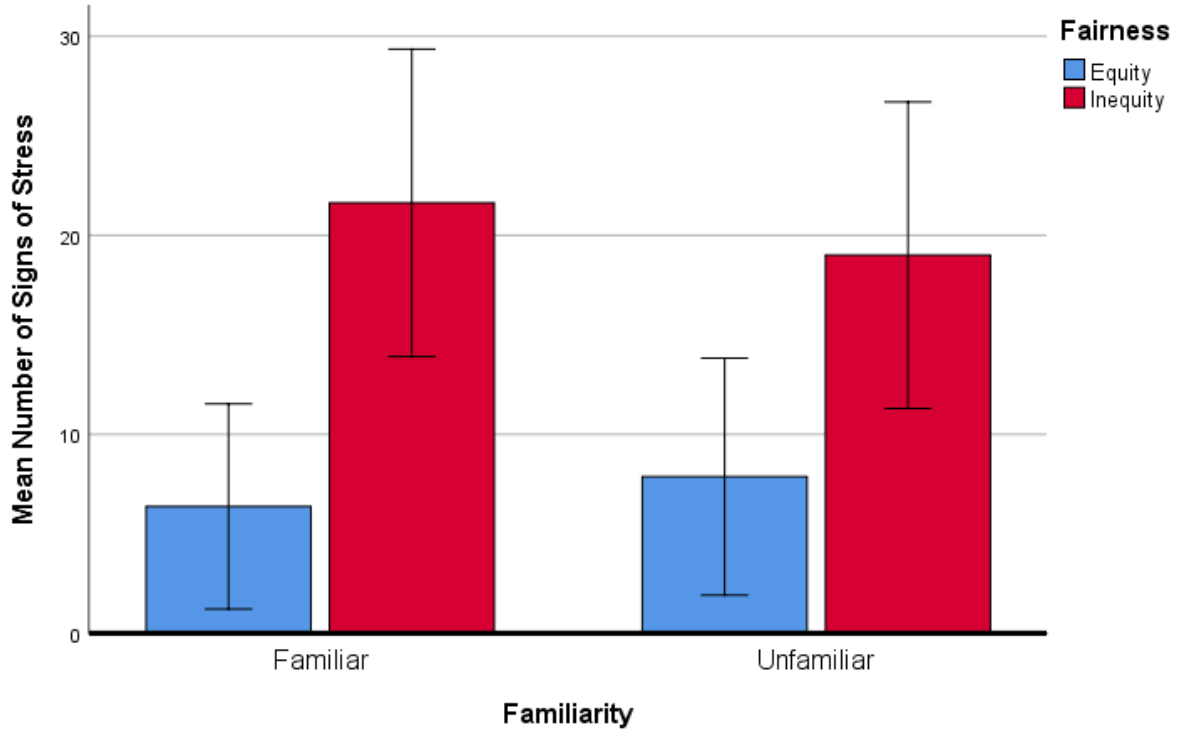

Figure 2. Mean amount of stress per condition. This figure shows the mean number of times the dogs in the equity familiar (M= 6.38, SD= 6.163), equity unfamiliar (M= 7.88, SD= 7.120), inequity familiar (M= 21.63, SD= 9.242), inequity unfamiliar (M= 19.00, SD= 9.212) conditions displayed signs of stress and their standard deviations.

Effects of Fairness and Familiarity on Withdrawal

To test the effects of inequity and tester familiarity on the amount of withdrawal displayed by the subject dog, a 2x2 within-subjects ANOVA was conducted. The two independent variables were Fairness, with two levels (Equity and Inequity), and Familiarity, with two levels (Unfamiliar and Familiar). The dependent variable was scored on a discrete scale from zero and upwards.

Figure 3 illustrates the means and standard deviations of the analysis. The means for each of the conditions were as follows: equity familiar (M= 0.00, SD= 0.000), equity unfamiliar (M= 0.13, SD= 0.354), inequity familiar (M= 4.13, SD= 10.077), inequity unfamiliar (M= 7.88, SD= 9.628). There was no significant main effect for fairness $F(1, 7) = 5.283$, $p = 0.055$ ($\eta^2 = 0.430$) and no main effect for familiarity $F(1, 7) = 0.745$, $p = 0.416$ ($\eta^2 = 0.096$). There was no interaction found between fairness and familiarity $F(1, 7) = 0.606$, $p = 0.462$ ($\eta^2 = 0.080$).

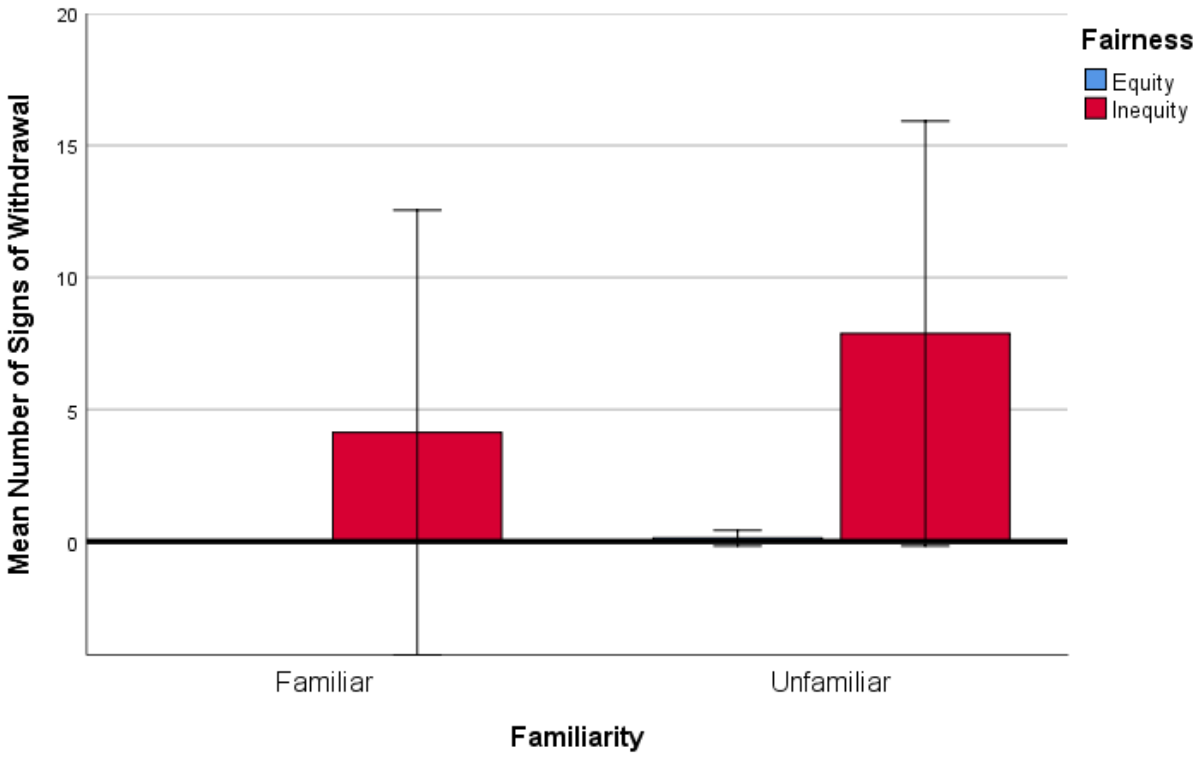

Figure 3. Mean amount of withdrawal per condition. This figure shows the mean number of times the dogs in the equity/familiar (M= 0.00), equity/unfamiliar (M= 0.13), inequity/familiar (M= 4.13), inequity/unfamiliar (M= 7.88) conditions displayed signs of withdrawal.

Effects of Fairness and Familiarity on Refusals

To test the effects of inequity and tester familiarity on the number of refusals displayed by the subject dog, a 2x2 within-subjects ANOVA was conducted. The two independent variables were Fairness, with two levels (Equity and Inequity), and Familiarity, with two levels (Unfamiliar and Familiar). The dependent variable was scored on a discrete scale from zero to 20.

Figure 4 illustrates the means and standard deviations of the analysis. The means for each of the conditions were as follows: equity familiar (M= 0.00), equity unfamiliar (M= 0.00),

inequity familiar (M= 3.00), inequity unfamiliar (M= 3.38). There was a significant main effect for fairness $F(1, 7) = 6.023$, $p = 0.044$ ($\eta^2 = 0.462$) and no main effect for familiarity $F(1, 7) = 0.084$, $p = 0.780$ ($\eta^2 = 0.012$). There was no interaction found between fairness and familiarity $F(1, 7) = 0.084$, $p = 0.780$ ($\eta^2 = 0.012$).

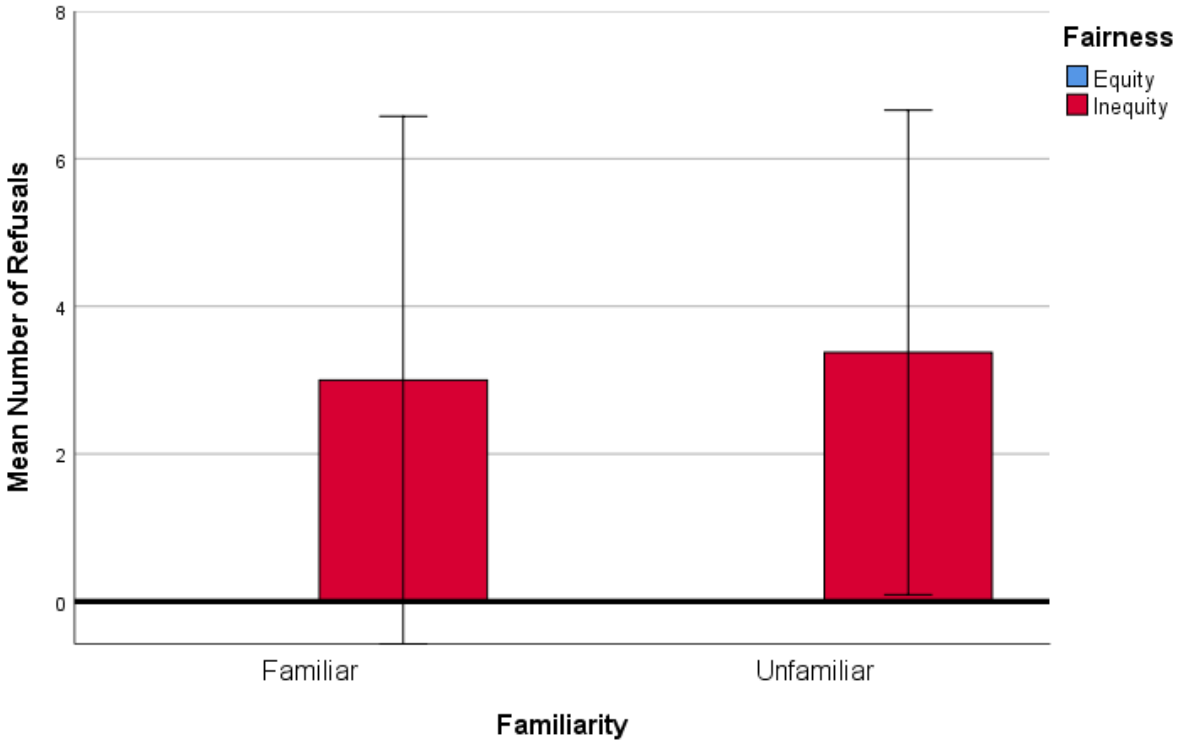

Figure 4. Mean number of refusals per condition. This figure shows the mean number of times the dogs in the equity/familiar (M= 0.00), equity/unfamiliar (M= 0.00), inequity/familiar (M= 3.00), inequity/unfamiliar (M= 3.38) conditions refused to give paw after 10 commands.

Because the sample size was so small and in congruence with statistical analysis reported by Range et al. (2009), a set of non-parametric analyses were performed. All dependent measures were analyzed in SPSS using the Wilcoxon Signed Rank Test to compare the familiar and unfamiliar inequity conditions. In accordance with the above results, no significant differences were found.

Discussion

As the results reveal, some predictions were supported while others were not. The first hypothesis, which stated that the equity conditions would not differ from each other on any of the dependent measures was supported by the data, indicating that dogs are not differentially affected by the familiarity of the experimenter when they are being rewarded equally.

The second hypothesis, that both inequity conditions would score significantly higher on all dependent measures compared to the equity conditions was based on the first inequity study done with dogs by Range et al. (2009). They tested dogs on paw giving in a variety of conditions: equity, in which both dogs were rewarded, quality inequity, in which the partner dog received a high value reward and the subject received a low value reward, reward inequity, in which only the partner dog was rewarded, and a variety of control conditions. They found that only the reward inequity condition significantly differed from the equity condition on the number of trials dogs complied with the command; this result, along with the results of the control conditions, led the researchers to conclude that there was evidence of inequity aversion in dogs.

The second hypothesis was supported on every measure except for signs of withdrawal, successfully replicating the results found by Range et al. (2009, who did not look at withdrawal as a dependent measure). However, withdrawals still followed a general trend of being higher in the inequity conditions and had near significance with a $p = 0.055$. Overall, the results of the current study are interpreted to mean that dogs do perceive and respond to being rewarded unequally, indicating that they are inequity averse, as was concluded by Range et al. (2009) and researchers in subsequent studies (Brucks et al., 2016; Essler et al., 2017).

Horowitz (2012) theorized that the increased lack of response and negative reactions observed in inequity conditions in Range et al.'s (2009) study were the result of extinction of the unrewarded response, rather than inequity aversion. However, Range et al.'s (2009) study found that subjects gave their paw significantly less in the reward inequity condition, compared to the no-reward condition in which they didn't get a reward without a partner present, indicating that the presence of a rewarded partner is a large factor in the decreased responses. Further, typically during extinction, responses steadily decrease until they do not occur anymore, or there is an extinction burst, meaning there is a drastic increase in the unrewarded response and negative reactions, after which they steadily decrease again (Jakovcevic, Elgier, Mustaca, & Bentosela, 2012). The pattern of refusals was analyzed in the current study's data to see if dogs followed this tendency in the inequity trials and it was found that they did not. In fact, many dogs would switch back to responding to the first paw command following a trial in which many commands had been given to them or they had fully refused to obey. Based on this much more erratic pattern of refusal and compliance, it is unlikely that negative reactions in the inequity conditions are only a product of extinction.

The hypothesis that was not supported by the data was that dogs tested by an unfamiliar person in the inequity condition would score significantly higher on the dependent measures than when tested by a familiar person; none of the dependent measures showed a significant difference. This hypothesis was based on literature which found that dogs read cues more successfully from humans they are familiar with (Cunningham & Ramos, 2014) and that dogs' choices can be influenced by their owners, even in the direction of making less favorable choices for themselves (Prato-Previde et al., 2008). Not only that, but when those dogs were scored on separation related issues, dogs with more attachment to their owners were found to be more

easily influenced (Prato-Previde et al., 2008). Finally, Essler et al.'s (2017) results showed that wolves and dogs raised with no human contact responded to quality inequity, unlike pet dogs tested in other studies (Range et al., 2009; Brucks et al., 2016). Their rationale for this hypothesis was that close socialization of dogs with their owners causes them to ignore unfavorable outcomes, rather than the conclusion of previous research that canines only possess primitive levels of inequity aversion (Range et al., 2009; Brucks et al., 2016). All these studies taken together show a pattern in which dogs are influenced by humans to ignore unfavorable outcomes and more so by humans they are closely attached to; hence, it was predicted that this pattern would be true in an inequity aversion paradigm as well.

Although the hypothesis was not supported with significant results, it is of note that the general trend of the differences in most of the dependent measures do follow the hypothesis; other than the signs of stress, which were slightly higher with the familiar tester (M= 21.63) than with the unfamiliar one (M= 19.00), number of commands, signs of withdrawal, and refusals were all lower in the inequity familiar condition, than the inequity unfamiliar one.

This lack of significant findings could be explained by a few different hypotheses. One is simply that familiarity does not have any effect. This could be because it generally doesn't matter to the dogs who is rewarding them, although this explanation does not seem likely based on the findings that relationships with humans affect dogs' choices in a variety of areas (Cunningham and Ramos, 2014; Prato-Previde et al., 2008; Essler et al., 2017). Rather, as shown by the results, even with a very small sample size and a lot of individual variability between the dogs, inequity was still found to cause significantly strong negative reactions. Familiarity may be a much weaker variable compared to the very robust effect of being treated inequitably, which

may override any attachment or conditioning dogs have to their owners, thereby nullifying any effects familiarity would otherwise have.

It is also a possibility that familiarity does have an impact on inequity aversion, but small sample size and individual variability may have obscured the effects of it. As an example of how extreme these variations can be in the inequity conditions, a male standard poodle by the name of GusGus only needed 22 commands when his owner was doing the testing, whereas with the unfamiliar experimenter he was given a total of 66 commands, a number exactly three times higher. Conversely, a male mixed breed dog, Bo, was given 119 commands by his owner in the inequity condition, and 51 by the unfamiliar tester, a little over halfway less. The opposite reactions of these two dogs based on familiarity cannot be explained by order of testing either, as it so happened that they were both first tested with their owners, followed by the unfamiliar tester. On the other hand, two dogs did not decrease their paw giving at all in either of the inequity conditions compared to the equity ones. Researchers have investigated how and why these individual differences can manifest and one study found that inhibitory control can have an effect (Brucks, Range, & Marshall-Pescini, 2017); dogs with higher compulsivity were found to be more eager to continue giving their paw regardless of how they were being rewarded. Therefore, mechanisms like inhibitory control may play a part in the expression of individual differences. With a sample size of eight, difference like these can potentially obscure the overall effect of the variable and thus testing with a larger sample size is imperative to tease out more subtle effects.

The original aim of the study was to recruit 30 participants in order to have a comparable sample size to that of previous research, most of which had 30 to 40 dogs as subjects. There were 12 responses to an initial recruitment email sent out to all faculty and staff members of The

College of Wooster, only seven of which followed through with test scheduling and no responses were received from recruitment flyers posted in the local dog shelter, animal hospital and doggie daycare. Surprisingly, campus therapy did dogs did not provide a good resource either as most of the dogs did not know how to give paw. The combination of time constraints, behavioral requirements for the dogs, and ability to reach out to wider community all contributed to the small sample size.

A final factor that may have obscured the full effects of familiarity was the respective quantification of stress and withdrawal signals. Stress signals encompassed a variety of behaviors, including mouth licking, panting, whining, yawning, and scratching. Each type of signal was not counted as a variable on its own because each dog differed on which of these behaviors they expressed. Further, treating these behaviors as one measure made the results comparable to past work, as multiple other studies used the same procedure (Brucks et al., 2017; Essler et al., 2017; Range et al., 2009). Signs of withdrawal included multiple behaviors as well, such as turning away from the experimenter or backing away. Although this variable was not included in other studies on inequity aversion, it was observed during testing that these behaviors mostly only occurred in the inequity trials, hence they were included as their own variable. These behaviors appeared to be ones of avoiding contact with the experimenter, the increase of which during the inequity conditions would possibly indicate them as a reaction to unequal treatment. The withdrawal signals seem to be similar to the finding that subject dogs took a significantly longer time to come into close proximity with the experimenter after being in the reward inequity condition compared to the equity condition (Brucks et al., 2016), again an avoidance of contact. This avoidance, both during testing as observed in the current study and post-testing as found by Brucks et al. (2016), supports the theory that inequity aversion is a mechanism of cooperation

(McGetrick & Range, 2018), as it would decrease the tolerance of participating individuals towards unequitable partners.

Although both stress and withdrawal signs were important measures to include, as previously stated, their quantification may have not been an accurate measure of dogs' responses. Both variables were measured by tallying the number of times they were observed happening, which does not reflect the intensity or duration of either one. As an example, for stress signals it was observed during video analysis that a dog may have panted during the whole trial, which would have been marked as one signal, yet over the course of 20 trials, some dogs would open their mouths much wider and pant at a more rapid pace or with greater inhalation than when they first started; therefore, a quantity of one in the beginning trials was not necessarily equivalent to a quantity of one in later trials. As an example for withdrawal signs, the length of the withdrawal would vary greatly and seemed to increase throughout the duration of the trials, which is also not reflected in the current data. More resources would be required to do more nuanced measurement of those two variables, but it is a possibility for future exploration that could potentially reveal more about the effects of familiarity than shown in the current results, as well as inequity aversion and cooperation.

Another finding of note is that stress was the only dependent measure that did not match the hypothesis of familiarity causing lesser negative reactions in the inequity conditions, even in general trend (without significance) as the rest did; stress was higher in the familiar inequity condition than the unfamiliar inequity condition. The difference is not very big (inequity familiar had a M= 21.63 and inequity unfamiliar had a M= 19.00), but if taken as an indicator of differences that might be found in future studies, it in fact does not go against the original theory driving the hypothesis. I predicted that dogs would have lower levels of negative reactions

because they would be more tolerant of unequal treatment from highly familiar humans with whom they have had many positive interactions with and due to more training and conditioning with them. What this theory failed to take into account was that although they may be more tolerant of inequity, it does not mean they perceive it less than with an unfamiliar person. Therefore, it follows that number of commands given, withdrawal, and refusals, which are voluntary actions, would be lesser if the dogs were being more tolerant. Signs of stress though, such as panting, yawning, and mouth licking, are involuntary reactions that would occur equally in both inequity conditions as a response to perceiving it occurring. However, if the argument is that dogs are more likely to comply with a familiar person, then it could also follow that it would be harder (and more stressful) to not obey them, which we know they did in comparison to the equity condition. Thus, the trends of the results still fit the original theory, but the resulting hypothesis for stress may have been wrong.

In summary, results from both inequity conditions support the existence of inequity aversion in dogs, as well as its possible role in cooperation, but there is still much room for further investigation. The findings of this study did not show a significant effect of familiarity on the reactions of dogs to inequity aversion. Nevertheless, overall trends in differences between the inequity conditions indicate that there may be more of an effect of familiarity than shown here and future studies have many avenues open to them for more precise investigation. A larger sample size and more nuanced quantification of the dependent measures are a few options that could potentially show a more differentiated outcome as a result of differing familiarity and would be interesting follow up experiments for future research.

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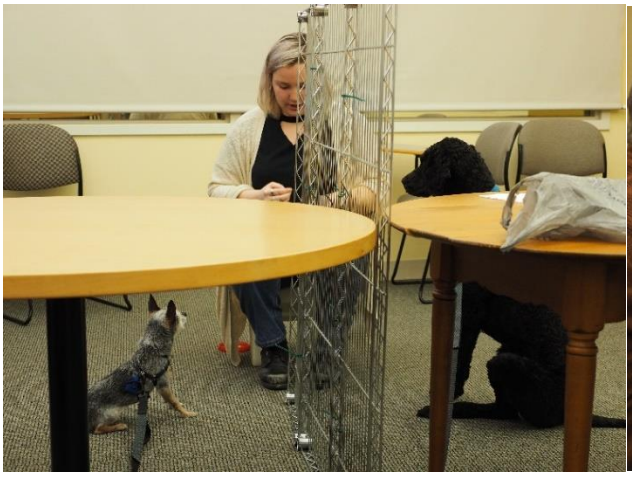
Appendix A



Appendix B

Application to Perform Research Involving Vertebrate Animals

Date of Submission: 11/11/18

Project Title: Effects of Tester Familiarity on Inequity Aversion in Dogs

Objective (no more than 100 words description of the main experimental objective of your research):

There are two primary objectives of my study. The first one is to replicate partially the results found in Range, Horn, Viranyi, and Huber's (2009) study, in which they found evidence to support the notion that dogs are inequity averse. Second, I will add a so far completely uninvestigated variable of tester familiarity, meaning each dog will be tested in the equity versus non-equity condition by the primary investigator, an unfamiliar tester, and their owner, a familiar tester, respectively. I predict that the dogs will show more negative responses in the inequity condition when tested by the unfamiliar investigator.

Range, F., Horn, L., Viranyi, Z., & Huber, L. (2009). The absence of reward induces inequity aversion in dogs. *Proceedings of the National Academy of Sciences, 106*(1), 340–345. https://doi.org/10.1073/pnas.0810957105

Investigator/Project Information

Investigator's Name: Kia Radovanovic

Local Address: 1189 Beall Ave C-2463, Wooster, OH 44691

Local Telephone No.: 330-201-7658

Emergency Telephone No.: 718-710-0190

E-Mail Address: kradovanovic19@wooster.edu

Co-Investigators' Names, Addresses, Telephone Numbers: N/A

If a Student, Advisor's Name & Department: Claudia Thompson, Department of Psychology

Type of Project (Check appropriate blank in **each** columns):

☒ New	☐ Faculty Instruction
☐ Continuation (without modifications)	☐ Faculty Research
☐ Renewal (with modifications	☐ Student Research
☐ Other (please specify):	☒ Independent Study

Period of Experimentation (Inclusive dates): November 1st , 2018- March 25th, 2019

If your experiment involves the use of Biohazards, Radioisotopes or Chemical Carcinogens, please contact the Chair of the IACUC committee before continuing.

Assurance of Investigator: I will abide by all Federal, State, and local regulations governing the use of animals in research. I will advise the Animal Care and Use Committee at the College of Wooster, in writing, of any significant changes in the procedures described below. *(Note: Federal regulations require that you report violations of the Animal Welfare Act to the Office of the Animal Care and Use Committee or to a member of that committee.)*

The proposed research does not unnecessarily duplicate previous work and is justified on scientific grounds. The chief investigator assures the College that an appropriate search of the literature has been made to verify this justification.

I understand that any change to the protocol described below must be approved by the IACUC before it is implemented.

Signature of Principal Investigator: _____Kia Radovanovic_____

Typed Name of Principal Investigator: Kia Radovanovic

Date: 11/09/2018

Adviser's Endorsement: I have reviewed this proposal and discussed it with the investigator in the context of provisions of the Animal Welfare Act, the U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training, and other statutes and regulations relating to animals. I have determined that they have been provided with a copy of these regulations and information concerning the care of laboratory animals. The investigator assures me that they have received appropriate training in the use and care of animals necessary to conduct the proposed research from a member of the IACUC.

Comments: Because Kia will be testing dogs not in a laboratory setting and will not be responsible for their care, I have not discussed USDA regulations or Animal Welfare Act training programs with the investigator.

Signature of Advisor: ***Claudia R. Thompson***

Typed Name of Advisor: Claudia Thompson

Date: ……11/9/18

PROJECT DESCRIPTION

Summary: Provide a brief, plain-language summary of the proposed use of animals. Describe the overall objectives, hypotheses, and potential value of the study. Be sure to include the rationale for your choices – why that maze, that blood draw, that variable, etc., sometime just saying that you will do it does not explain why it is an essential part of your experiment. Include references to scientific documentation, but avoid use of jargon and abbreviations. **This section should be understandable to a member of the general public.**

There are two primary objectives of my study. The first one is to replicate partially the results found in Range, Horn, Viranyi, and Huber's (2009) study, in which they found evidence to support that dogs have a negative reaction to being unequally rewarded for the same labor, a reaction argued to be indicative of inequity aversion. Inequity aversion is the occurrence of a negative reaction in response to the same actions yielding outcomes of differing value (Fehr & Schmidt, 1999). My study will test two conditions from the original study: equity, in which both dogs are rewarded equally, and inequity, in which only the partner dog is rewarded, the two conditions showing the most consistent findings of inequity aversion in the original study (Range et al., 2009). Based on their findings (Range et al., 2009), my hypothesis is that the pet dogs will show significantly more negative reactions during the inequity condition compared to the inequity condition.

Second, I will add a so far completely uninvestigated variable of tester familiarity, meaning each dog will be tested in the equity and inequity condition by an unfamiliar tester (the primary investigator) and a familiar one (their owner) to see if they will yield different results. In past research, familiarity was only studied in regards to affiliation to the partner animal, rather than the experimenter; with primates, it has been found that closer bonds lead to less negative reactions to inequity aversion (Brosnan, Schiff, & de Waal, 2005), whereas with dogs the opposite was found (Range, Leitner, & Virányi, 2012). It is therefore a possibility that the relationship with the tester will have an effect on inequity aversion responses as well; as pointed out by Essler, Marshall-Pescini, and Range (2017), dogs may be more tolerant of unequal treatment from humans due to training and positive interactions throughout their life. Humans they have had more of these positive interactions with may then elicit more tolerance from the dogs, than someone they have had no contact with in the past. Based on this rationale, I predict that the dogs will have comparatively less negative reactions during the inequity condition when tested by the

familiar tester. In the equity condition, I predict that there will be no difference in reactions between the familiar and unfamiliar tester conditions.

This will be tested by having the dogs placed side by side, in view of each other, but with a metal barrier between them as additional back up in case of unexpected aggression towards each other. Additionally, they will be secured by their leashes to a hard point behind them, again as an extra precaution so that they cannot reach the experimenter in case of aggression.

Since the equity test requires effort for a reward, the dogs will be asked one by one to give their paw to the experimenter. The partner dog will be rewarded after each trial of giving the paw, whereas the subject dog will only be rewarded in the equity condition. The reward that will be used is cut up hot dogs, as it is a commonly favored treat by dogs, therefore representing a high value reward. The dependent variables being measured will be the number of times a dog obeys the command, the number of commands given, and signs of distress displayed by the subject dog (mouth licking, panting, and pacing). A full description of the step-by-step testing procedures appears below.

Brosnan, S. F., Schiff, H. C., & de Waal, F. B. M. (2005). Tolerance for inequity may increase with social closeness in chimpanzees. *Proceedings of the Royal Society B: Biological Sciences*, *272*(1560), 253–258. https://doi.org/10.1098/rspb.2004.2947

Essler, J. L., Marshall-Pescini, S., & Range, F. (2017). Domestication Does Not Explain the Presence of Inequity Aversion in Dogs. *Current Biology: CB*, *27*(12), 1861-1865.e3. https://doi.org/10.1016/j.cub.2017.05.061

Fehr, E., & Schmidt, K. M. (1999). A Theory of Fairness, Competition, and Cooperation. *The Quarterly Journal of Economics*, *114*(3), 817–868.

Range, F., Horn, L., Viranyi, Z., & Huber, L. (2009). The absence of reward induces inequity aversion in dogs. *Proceedings of the National Academy of Sciences*, *106*(1), 340–345. https://doi.org/10.1073/pnas.0810957105

Range, F., Leitner, K., & Virányi, Z. (2012). The Influence of the Relationship and Motivation on Inequity Aversion in Dogs. *Social Justice Research*, *25*(2), 170–194. https://doi.org/10.1007/s11211-0120155-x

Animal Characteristics:

Species: Dogs Sex: Both

Age/Weight: N/A Number: 30

Location of Housing: Privately owned homes

Vendor/Source & USDA License No. if animals are purchased outside of the College of Wooster: **N/A**

Reason for selecting these species for use (include literature citations supporting the reasons given):

Many animals have been tested for inequity aversion, primarily primates. This includes chimpanzees (Brosnan, Schiff, & de Waal, 2005), capuchin monkeys (Brosnan & de Waal, 2003), and gorillas (Bräuer, Call, & Tomasello, 2006). Far fewer studies have been done with non-human and nonprimate animals. However, Range, Horn, Viranyi, and Huber (2009) tested dogs and found that they may show evidence of inequity aversion. Since then, more studies have been conducted with dogs, but with many mixed results (McGetrick & Range, 2018). As there has been trouble replicating the Range et al. (2009) study and dogs are widely available in the Wooster community, they were selected as the best species to test inequity aversion with.

Bräuer, J., Call, J., & Tomasello, M. (2006). Are apes really inequity averse? *Proceedings of the Royal Society B: Biological Sciences*, *273*(1605), 3123–3128. https://doi.org/10.1098/rspb.2006.3693

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McGetrick, J., & Range, F. (2018). Inequity aversion in dogs: a review. *Learning & Behavior*. https://doi.org/10.3758/s13420-018-0338-x

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If you are using wild or exotic species, have you or your adviser obtained State and Federal permits to keep them?

☐Yes ☐No ☒N/A

If yes, list permit numbers and source of licenses:

Justification for the numbers of animals to be used: Is the above number the minimum required to obtain statistically valid results? Explain your reasoning and include documentation from other studies that have completed similar experiments (e.g., what numbers are recommended in statistics handbooks or in related published reports?). You should not state that you will use a particular number simply because that is what is available to you – to use too few or too many animals to achieve statistical significance is a violation of animal welfare.

A power analysis of moderate effect and 80% power indicated that a sample size of 64 dogs would be required. As this is not a realistic goal, my aim will be to test 30 dogs. Nevertheless, this sample size will have comparable results to those of past studies, as most literature cites sample sizes smaller than 64 dogs. Range, Horn, Viranyi, and Huber (2009), had a sample size of 29 in their study that I will be partially replicating. Other studies have had varying sample sizes: 22 dogs (Range, Leitner, & Virányi, 2012); 36 dogs (Brucks, Essler, Marshall-Pescini, & Range, 2016); nine dogs and nine wolves (Essler, Marshall-Pescini, & Range, 2017), and 36 dogs (Horowitz, 2012).

Brucks, D., Essler, J. L., Marshall-Pescini, S., & Range, F. (2016). Inequity Aversion Negatively Affects Tolerance and Contact-Seeking Behaviours towards Partner and Experimenter. *PLOS ONE*, *11*(4), e0153799. https://doi.org/10.1371/journal.pone.0153799

Essler, J. L., Marshall-Pescini, S., & Range, F. (2017). Domestication Does Not Explain the Presence of Inequity Aversion in Dogs. *Current Biology: CB*, *27*(12), 1861-1865.e3. https://doi.org/10.1016/j.cub.2017.05.061

Horowitz, A. (2012). Fair is Fine, but More is Better: Limits to Inequity Aversion in the Domestic Dog. *Social Justice Research*, *25*(2), 195–212. https://doi.org/10.1007/s11211-012-0158-7

Range, F., Horn, L., Viranyi, Z., & Huber, L. (2009). The absence of reward induces inequity aversion in dogs. *Proceedings of the National Academy of Sciences*, *106*(1), 340–345. https://doi.org/10.1073/pnas.0810957105

Range, F., Leitner, K., & Virányi, Z. (2012). The Influence of the Relationship and Motivation on Inequity

Aversion in Dogs. *Social Justice Research, 25*(2), 170–194. https://doi.org/10.1007/s11211-0120155-x

Procedures: Describe sequentially **all procedures** (surgical and non-surgical) to be carried out on live animals. If you are completed a behavioral analysis of the animals, include as complete a protocol as possible – we want to know how the animals will be treated in addition to knowing what will happen to them experimentally. Where appropriate the end point of procedures must be clearly defined. Include documentation.

Method

Subjects

Thirty dogs of varying age and breed will be used in this study. All 30 dogs will be privately owned pets and will have to know to give their paw on command prior to the testing procedure as a prerequisite to participation. All dogs will be screened for any aggression in the presence of food or towards other dogs; owners will be verbally asked for any previous displays of aggression. Dogs living in the same household will not be tested together in order to control for stronger affiliative ties. No food or water deprivation will be done; however, owners will be asked not to feed their dogs within the two hours prior to testing to control for food satiation.

Materials

As there will be no quality inequity testing, only one type of reward will be used: hot dogs cut up into roughly equal small pieces. A metal wire barrier will be placed in between two dogs, so that they will be able to see each other, but not reach each other. Two leashes of equal length will be used to prevent dogs from reaching the tester during the trials. A see-through plastic bowl will be used to hold the treats in all trials. Thin leather gloves will be used as an extra protective layer by all persons doing testing. Finally, a Nikon 2500 camera will video record each testing trial.

Design

The results from this study will be analyzed using a 2 x 2 mixed design. There will be two independent variables: *familiarity of tester*, with two levels (*unfamiliar*, the primary investigator, and *familiar*, the dog's owner); and *fairness*, with two levels (*equity*, in which both dogs received the same reward, and *inequity*, where only the partner received the reward after task completion). All dogs will complete both conditions sequentially, so *fairness* and *familiarity* are within subjects factors. Three dependent variables will be measured: signs of distress (mouth licking, panting, and pacing), number of times the command was followed, and number of commands given.

Procedure

The dogs will be tested on college grounds, two at a time. They will be brought into a lab space in Morgan Hall Social/Developmental Lab Room, set up as a comfortable, home-like "sitting room." They will be placed side by side, with a freestanding metal wire barrier placed between them, in order to prevent the dogs reaching each other in the event of any aggression displays. Their leashes will also be secured to a hard point behind them to prevent them reaching the tester.

One tester, the subject dog's owner, will be the same for every unfamiliar trial, whereas one tester, the primary investigator, will be the same for every familiar trial. The tester will kneel in front of the dogs, facing them. The bowl containing the rewards will be placed in front of the tester's legs so as to be visible to both dogs. This positioning will remain constant for both fairness conditions. Testers will wear long sleeves and thin leather gloves as an added protective layer.

Every dog will serve as both partner and subject for each condition. Each testing session will consist of 80 trials, 20 per condition. The equity condition will always be tested first, to

avoid frustration for the following condition. It will be followed by a five minute break, after which the inequity condition will be tested. The familiar and unfamiliar conditions will randomly vary so as to counterbalance the conditions and will be conducted exactly the same by both testers.

Equity condition. Trials will begin once both dogs are sitting. The tester will first ask the partner dog for their paw by holding out their hand and saying the command "paw." After two seconds, if the dog has not complied, the command will be repeated. If the partner dog gives its paw, it will be rewarded with a treat. Immediately following this, the subject dog will be asked to give its paw following the exact same procedure of the hand and "paw" command. The subject dog will also be rewarded if it complies with the command. Each command will be given a maximum of 10 times per trial, after which the trial will be terminated if there is still no compliance.

Inequity condition. As with the equity condition, trials will begin once both dogs are sitting. The tester will give the command to the partner dog first and reward it with the treat once it has complied. Immediately following this, the subject dog will be asked to give its paw. However, in this condition, the subject dog will not be rewarded for complying with the command. Again, each command will be given a maximum of 10 times per trial, after which the trial will be terminated.

[Form continues on next page]

LEVELS OF PAIN/BIOHAZARDS

Describe the level of pain, discomfort, or distress to which the animals in this project will be exposed by checking the appropriate blank(s) below. Please specify which parts of each category apply to your project in the space provided.

Levels of Pain - Discomfort - Distress

Category	
☒A	The research involves no pain, discomfort or distress greater than that produced by routine injections or venipuncture. Includes simple invasive procedures (e.g., injection, blood sampling), terminal anesthetic surgery, collection of tissues preceded by standard euthanasia. Involves behavioral testing with minor stress.
☐B	The research involves only short-term pain, discomfort or distress. Includes anesthetic survival surgery without significant post-op pain and/or functional deficit (e.g., gonadectomy, exploratory abdominal surgery), implantation of chronic catheters, shortterm physical restraint (less than 60 min) of awake animals. Involves induction of shortterm behavioral stress.
☐C	The research involves chronic maintenance of animals with a disease/functional deficit and/or procedures inducing moderate to significant, but tolerable pain, discomfort or distress. Includes major anesthetic survival surgery with significant post-op pain and/or functional deficit (e.g., orthopedic surgery on femur, amputation, invasion of large muscle mass); tumor inducement, radiation sickness, toxicity testing, physical restraint (more than 60 min) of awake animals, induction of moderate to significant behavioral stress.
☐D	The research involves pain, discomfort or distress (greater than that attending routine injection) which cannot/will not be alleviated/minimized through the administration of appropriate anesthetic, analgesic or tranquilizer drugs.

NOTE: The USDA has determined that any use of analgesics, anesthetics, or tranquilizers inflicts more than momentary or slight pain or distress on an animal.

[Form continues on next page]

CONSIDERATION OF ALTERNATIVES TO PAINFUL PROCEDURES N/A

Justify the use of living animals rather than alternatives such as mathematical models, cells/tissue/organ culture, or computer simulations.

Describe your consideration of alternative techniques to **reduce** the number of animals required to obtain valid results and/or **refine** animal use by lessening or eliminating pain or distress.

For the above questions, provide documentation of the sources consulted to determine that alternatives are not available. For literature searches, include a) the name of the database searched (e.g. Web of Science, PsycINFO, BIOSIS), b) the date the search was performed, c) the time period covered by the search, and d) the keywords or search strategy used. Consultations with advisors may be used to supplement literature searches and should include a) the name and qualifications of the person consulted and b) the date the consultation took place. You may also wish to consult the Animal Welfare Information Center (http://awic.nal.usda.gov)

_____ _____

Signature of the Principal Investigator Date

[Form continues on next page]

SURGERY

Will surgery be done on animals? **If yes, complete appendix A at the end of this form.**

☐ Yes ☒ No

NON-SURGICAL INVASIVE MANIPULATIONS

Will non-surgical invasive manipulation, such as blood collection, intubation, catheterization, be performed?

☐ Yes ☒ No

If yes, describe them:

OTHER ASPECTS OF ANIMAL CARE

If surgery is not involved, but drugs or other synthetic or natural products, other than those used to alleviate pain, will be administered to the animals, identify them and indicate the dosage, route of administration, and frequency of their use.

Will special foods (i.e., other than the normal diet) and/or water be required for the animals used in this project? **If yes, complete appendix B-1 at the end of this form.**

☒ Yes ☐ No

Will animals be restrained by chairs, slings, tethers, stanchions, metabolism cages or other devices? **If yes, complete appendix B-2 at the end of this form.**

☒ Yes ☐ No

Will animals be food or water-deprived? **If yes, complete appendix B-3 at the end of this form.**

☐ Yes ☒ No

EUTHANASIA/DISPOSITION OF ANIMALS

If death (rather than euthanasia) of the animal is the endpoint of the experiment: N/A

Explain why the animals must be allowed to die - why can't they be euthanized at some earlier point in the study?

If the animals will be euthanized at the end of the experiment:

Who will euthanize them:

Will they be euthanized with an overdose of Isoflo followed by cervical dislocation?

☐ Yes ☐ No

If no, what agent/procedure will be used? Include dose and route of administration (note: the method of euthanasia must conform to the AVMA guidelines):

Will disposal of the animal carcasses be by triple bagging and involve Laidlaw Disposal Company?

☐ Yes ☐ No

If no, how will the animal carcasses be disposed?

If animals will not be euthanized at the end of the experiment, what will happen to them?

The dogs are not under my care- shelter dogs will continue living in the shelter until adopted and personal pets will stay with their owners.

INVESTIGATOR: EXPERIENCE/TRAINING

Describe your qualification/experience to do this project and of any assistant(s) you may employ. Are you qualified to perform the surgeries, control pain, do euthanasia, and other aspects of this project?

I was a foster of service dogs in training for 4 Paws for Ability for 2 years which required training in operant conditioning and positive reinforcement techniques. These same skills will be used in the study when asking dogs to give their paw. Additionally, I was an animal husbandry intern at the Audubon

Zoo for 12 weeks of the summer of 2018, working with their African mammals. This position required learning how to read body language of animals, especially dangerous once, hence I am comfortable reading subtle cues in the dogs' responses. Finally, I have taken classes on animal cognition, learning, and behavior, in which we learned similar procedures to the one proposed in this study. Overall, I feel very qualified and confident in my past experiences aiding me in this study.

If you are a student and this is a student project (e.g., an Independent Study), who will train you in techniques required for the project?

As outlined in the previous question, I will not need to learn any additional skills required for my study.

What are the qualifications of this trainer?

N/A

In what techniques will you receive instruction?

N/A

REFERENCES:

APPENDIX A: SURGERY

Type of surgery:

☐ Non-recovery surgery ☐ Recovery surgery ☐ Multiple surgeries

If multiple surgeries are involved, justify their use.

Surgeon(s):

Location(s) of surgical suites to be used (building and room):

Specify anesthetic agents, analgesics, tranquilizers, and/or other methods used to alleviate pain during surgery. Include dose (e.g., mg/kg body weight), frequency of administration (e.g., daily) and route of administration (e.g., intraperitoneally) of each. **Note:** Federal regulations prohibit the use of muscle relaxants or paralytic drugs (e.g., succinylcholine or curariform drugs) alone for surgical restraint.

Agent 1

☐ Anesthetic ☐ Analgesic ☐ Tranquilizer ☐ Other

Name:

Dose:

Frequency of Administration:

Route of Administration:

Agent 2

☐ Anesthetic ☐ Analgesic ☐ Tranquilizer ☐ Other

Name:

Dose:

Frequency of Administration:

Route of Administration:

Agent 3

☐ Anesthetic ☐ Analgesic ☐ Tranquilizer ☐ Other

Name:

Dose:

Frequency of Administration:

Route of Administration:

Indicate the vital signs that will be used to monitor the presence of appropriate levels of anesthetic during surgery:

☐ Respiratory activity ☐ Body terperature ☐ Skin color
☐ Pedal reflex ☐ Corneal reflex ☐ Other (please specify):

If any anesthetic agent, analgesic, or tranquilizer listed above is a "controlled substance," identify the source:

Supplier:

State & State Permit No.:

Federal Permit No.

Describe the surgical procedures, including aseptic techniques, that will be used during surgery:

Post-Surgical Care

How long will animals be maintained postoperatively:

Where will animals be housed for postoperative care (building and room)

Initial 6-24 hours:

After 24 hours:

Will animals(s) be able to function normally (i.e., eat, drink, maintain their weight, move, etc.) postoperatively?

☐ Yes ☐ No

If no, what steps will be taken to maintain them?

How frequently will post-op exams be done:

By whom:

What analgesics and/or antibiotics (include the dose and route of administration, and frequency of use) will be used during post-op care?

Administered by whom:

Describe post-op care and identify the caretaker(s):

APPENDIX B: OTHER ASPECTS OF ANIMAL CARE

B-1: Special foods/water

Describe any special foods (i.e., other than the normal diet) and/or water that will be used in this project and justify their use:

Hot dogs will be used in this study. They are harmless to the dogs, but are necessary as a reward that is highly valued.

B-2: Restraint

For each method of restraint, indicate the following:

Method of restraint: Leash tied to hard point behind dog

Duration of restraint (hours? days?): Approximately one hour, or the duration of the testing session, of which there will be two

Frequency of restraint: Each dog will be tested in two days and restrained only during that time, approximately 1 hour for each day

How often the animal will be observed while restrained: It will be observed for the whole duration of it

Who will observe the restrained animal(s): the primary investigator, Kia Radovanovic

B-3: Food/water deprivation

For food or water deprivation, indicate the following:

Food or water-deprivation? Choose an item.

Deprivation schedule (how frequently? how long?):

Justify the use of food- or water-deprivation.

N/A

Recruitment Letter

Hello to everyone in the community!

My name is Kia Radovanovic and I am a senior Psychology major, with a focus on animal behavior, at The College of Wooster. I am currently in the process of doing my Independent Study, which revolves around our favorite companions- dogs! I am studying inequity aversion in dogs, or rather, I am looking at whether dogs will respond negatively to unfair situations. If you would like to see a fun example video of what this looks like with monkeys, definitely look at this short video https://www.youtube.com/watch?v=meiU6TxysCg

I am looking to compare how dogs react to unfair situations created by a familiar person (you) or an unfamiliar person (me). I am looking for dogs that **know how to give their paw on command** and that are **not aggressive around other dogs or food aggressive** (this is very important as we don't want to risk anyone being harmed in this process). The basic setup is that two dogs will be placed sitting next to each other, facing the experimenter, with a barrier between them and with their leashes fixed to a point behind them. The dogs will then be asked to give their paw one at a time and will be rewarded or not based on the condition being tested. This will be repeated 20 times per condition. As the familiar tester, you will be required to do this procedure for both conditions and then I will as well as the unfamiliar one. I will film each trial, but none of this footage will be posted or shown anywhere without your permission. My results depend on testing dogs in two different roles, so please be aware that I'm asking you to come in *twice* for testing.

If this is something you are willing to volunteer for and your dog meets the necessary requirements, please get in touch with me and we can work out further details. Furthermore, if you know any neighbors/friends/family who have dogs, forward this email to them too! If you are concerned about my experience with animals, I am happy to discuss my past experiences and knowledge with you as well.

Sincerely,

Kia Radovanovic

INFORMATION FOR DOG OWNERS COLLEGE OF WOOSTER

Effects of Tester Familiarity on Inequity Aversion in Dogs Principal Investigator: Kia Radovanovic

IS Advisor: Dr. Claudia Thompson

Purpose: You are being asked to allow your dog to participate in a research study, in which you will be asked to help. From your dog, we hope to gain greater insight into the existence of inequity aversion in dogs and whether their home environment makes them more inequity averse than shelter dogs.

Procedures: If you agree to have your dog participate, you will be asked to bring your dog to the college for two testing session. During testing, your dog will be asked to sit next to a partner dog with barriers between them so they cannot reach each other. The primary investigator will ask your dog to give its paw, after which it will either receive a piece of hot dog as a reward (if in the equity condition) or not (if in the inequity condition). This will be repeated 20 times for each trial. All trials will be filmed.

Also, if you agree to participate, you will be asked to test the dogs by asking for paw and giving small treats.

Risks: As with all animals, there is a risk of them showing aggression, especially with other animals and food involved. For this reason, I am recruiting dogs with low probability of aggression. Further, the dogs will be tethered and unable to reach each other and a barrier of fencing will separate them. It is also of note that changes/additions to a dog's diet may cause diarrhea.

Benefits: There are no direct benefits of participation. Indirect benefits for dog owners will be the satisfaction of their dogs participating in a research project, in addition to seeing the footage of their dog's behavior. The dogs will benefit by receiving socialization with another dog and many treats.

Confidentiality: All information provided about dog owners will be held confidential. The only questions asked of dog owners will concern their dogs: name, age, and breed.

Costs: Participation in this study will not cost anything but the time put in for testing.

Right to Refuse or Withdraw: You may refuse to allow your dog to participate in this study. If you decide to allow it, you may withdraw your approval and withdraw your dog from the study at any point during the experiment.

If you have any questions or concerns, please feel free to contact
Kia Radovanovic kradovanovic19@wooster.edu or Dr. Claudia Thompson crt@wooster.edu

By signing below, you will indicate that you have fully read and understood the information provided to you and that you are allowing your dog to be a part of the study.

Signature: _____ Date: _____