8-2017

Displays of Jealousy in Dogs

Cassandra D. Beck
cdb8853@rit.edu

Department of Psychology, College of Liberal Arts

Rochester Institute of Technology

Displays of Jealousy in Dogs

by

Cassandra D. Beck

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Experimental Psychology

August, 2017

We approve the thesis of Cassandra D. Beck

Date

John E. Edlund, Ph.D.

Associate Professor, Dept. of Psychology, RIT

Date

Joseph Baschnagel, Ph.D.

Associate Professor/Department Chair, Dept. of Psychology, RIT

Date

Tina Sutton, Ph.D.

Assistant Professor, Dept. of Psychology, RIT

Date

Rebecca Lohnes, M.S.C.D.B.C.

Behavior and Training Manager, Lollypop Farm Humane Society, Rochester, NY

Acknowledgements

I need to extend a huge thank you to my thesis advisor, Dr. John E. Edlund and my thesis committee, Dr. Joseph Baschnagel, Dr. Tina Sutton, and Rebecca Lohnes for their patience, input, support, and advice during the course of this project. I would also like to thank Lollypop Farm Humane Society and all of the owners who contributed their time in helping me to complete this project. I would also like to thank my family and friends for their constant support and guidance while I worked through this.

Abstract

Wolves (*Canis Lupis)* were domesticated into the common dog (*Canis Familiaris*) at least 15 thousand years ago. The domestication process changed wolves both physically and neurologically. Dogs now have a unique connection with humans, and display many of the same personality traits and cognitive deficits as humans do. Research by Harris and Prouvost (2014) has suggested that dogs can display jealous reactions. In this thesis, dogs were exposed to either a plastic Jack-O-Lantern stimulus or a plush dog stimulus and recorded their behavioral and physiological reactions to such stimuli. The results show that the majority of the differences in the dogs' behavior was in interest and over arousal in the jealousy condition. This result suggests a potential jealousy-like reaction, but the current research does not seem to replicate the findings of Harris and Prouvost (2014) where it can be definitively stated that the dogs were jealous.

Keywords: canines, jealousy, attention, interest, aggression, over arousal

Table of Contents

Displays of Jealousy in Shelter Dogs

Research involving the *Canis Familiaris'* (the common dog) evolutionary background is varied: some of the research on dog's ancestry with humans has suggested a connection dating back approximately 40-135 thousand years (through the use of mitochondrial DNA, Ostrander & Wayne, 2005), whereas other research (based on fossil records) suggests a connection of only 15 thousand years (Hall, Glenn, Smith, & Wyanne, 2015). An understanding of the amount of time that humans and dogs have been coexisting is necessary to understanding the underlying behavioral mechanisms of the modern day dog.

Mitochondrial DNA (mtDNA) is only passed down through the maternal lineage; therefore only the females in a population leave a traceable line (Ostrander & Wayne, 2005). mtDNA is often used to track the interbreeding of dogs and wolves in the wild, and it has been found that there is little interaction between the two (Vilà et al., 2003). Yet, dogs' ancestral mtDNA has been found to originate from one of four different groups. One of the groups contains the majority of the genetic diversity, therefore suggesting that the bulk of dogs have originated from this group.

The neurological differences between dogs and grey wolves (*Canis Lupis)* may be the key to understanding the modern day connection between humans and dogs. The genetic alteration that occurred, presumably, from domestication may have involved a change in the expression of the genes in the dog's hypothalamus, part of the emotional center of the brain (Ostrander & Wayne, 2005). Given that dogs and wolves are genetic cousins and can interbreed, this neurological change suggests that dogs' brain structure evolved during the domestication process.

The hypothalamus is known as the emotional center of the brain: it is a small area that is centrally located under the cerebrums and is part of the limbic system. In dogs and humans, it has been shown to control emotional, endocrinological, and autonomic responses. Domesticated canines have been found to have a different expression of the genes in their hypothalamus of their brain as compared to wolves and coyotes (Ostrander & Wayne, 2005). The difference in gene expression has not been compared to that of a human's hypothalamus, but the dog's hypothalamus is highly diverged from the wolf in a relatively short period of time. The results of a study by Saetre et al. (2004) suggest there is an effect of domestication on the development of the canine brain; the differences in a wolf's and a dog's hypothalamus could be the result of the change in shelter, food sources, and daily interactions.

Research conducted in Russia supports the theory that domestication has changed the gene expression in the hypothalamus of dogs. Researchers in Russia would put a gloved hand into the kennels of wild foxes and, if their reaction was one of calm, those foxes were chosen to reproduce with other foxes also deemed to be calm. With time, through only selecting for tameness, the researchers were able to replicate the domestication process (Trut, 2001 as cited by Saetre et al., 2004). The pseudo-domestication that the researchers were able to create not only changed the foxes' behavior to be more playful and dog like, but it also eliminated the normal seasonal mating processes of the foxes, instead creating a more dog-like mating cycle. It has been suggested that these behavioral changes could be due to the impact that domestication had on the foxes' hypothalamus. Despite the differences between dogs and wolves' hypothalamuses, the gene expression in other areas of the limbic system, such as the amygdala and frontal cortex (which research suggest is involved in jealousy; Kelley, Harmon-Jones, Eastwick, & Schmeichel, 2015), remained relatively the same. Any variations that the researchers were able

to detect were seen to be normal variation in genes, as opposed to an evolutionary change (Saetre et al., 2004). In addition, oxytocin, a chemical that is most commonly shown to regulate the pro-social behaviors of humans, has been shown to directly affect the hypothalamus of dogs (Hernádi, Kis, Kanizsár, Tóth, Miklósi, & Topál, 2015).

Research has suggested that there is a connection between oxytocin and human directed social behavior in canines (Hernádi, Kis, Kanizsár, Tóth, Miklósi, & Topál, 2015). For instance, humans have been able to use oxytocin to alter the reactions of dogs to certain threatening situations. In a study looking at the reactions of canines to threatening situations, it was found that dogs will react with an increase in positive behaviors (e.g., tail wagging, ears up) if they had been given oxytocin intranasally prior to the threatening experience. Physiologically, oxytocin intranasally administered to dogs has been shown to decrease heart rate and increase heart rate variability (Kis, Kanizsár, Gácsi, & Topál, 2014). But, like humans, oxytocin does not decrease the amount of aggressive behaviors the dogs will display in a threatening situation (Hernádi et al., 2015). Other chemicals, such as synthetic pheromones, also have been shown to moderate canine behavior.

When dogs are separated from their owners and receiving treatment in a hospital, the dogs are under highly stressed conditions. The dogs can exhibit anorexia, shaking, destructive behavior, and vocalizing. A synthetic pheromone called a dog appeasing pheromone, or DAP, has been shown to help decrease anxiety in dogs that are in hospitalized environments (Kim, Lee, Abd el-aty, Hwang, Lee, & Lee, 2010). Furthermore, shelter dogs that are exhibiting stress due to the noisy and condensed environment have also been shown to react positively to DAP (Tod, Brander, & Waran, 2005). Use of DAP in shelter dogs has resulted in a decrease in barking and an increase in resting.

Dogs have been shown to display similar cognitive traits to humans. Research on dog's cognitive abilities has shown that young dogs have been known to perform very well on visuo-spatial tasks and tasks involving working memory systems (Adams, Chan, Callahan, Siwak, Tapp, Ikeda-Jones, & Milgram, 2000a). In addition, canines suffer from a decrease in visuo-spatial abilities with age (Chan, Nippak, Murphey, Ikeda-Douglas, Muggenburg, Head, & Milgram, 2002). Whether this is due to the shared evolutionary history of humans and canines is not clear.

Aside from cognitive delays in aging canines (e.g- require longer training periods, reduced memory capacity), there are also similarities in the physical neurobiological decline in humans and dogs. Plaques in the brain called β-amyloid are widely found in the brains of aging canines, but they are also found in the brains of humans with Alzheimer's disease (Head, McCleary, Hahn, Milgram, & Cotman, 2000). These plaques are widely associated with dogs and humans for a decrease in cognitive capacity, known as Canine Cognitive Disfunction. Therefore, dogs and humans display many of the same physical (e.g., prefrontal cortex deficits, β-amyloid protein presence) and cognitive delays (e.g., decrease in working memory systems) associated with aging (Adams, Chan, Callahan, & Milgram, 2000b).

Studies comparing canine and human personalities have shown that a dog's personality is just as diverse and can be judged just as accurately as a human's personality (Gosling, Kwan, & John, 2003). This suggests that, as many dog owners realize, canines each have unique personalities of their own, which is perhaps an evolutionary adaptation for living with humans. Furthermore, this research implies that, just like humans, canines can react differently to situations depending on their personalities.

Dog's social history

Dogs have also been shown to understand social cues from humans better than apes (Bräuer , Kaminski, Riedel, Call, & Tomasello, 2006). The amount of understanding that canine's display in social situations is both rigid and fluid. Dogs rigidly understand human social communication, as demonstrated in research studying pointing gestures (Bräuer et al., 2006), in research studying a dog's ability to learn from their owners via observation (Kubinyi, Topál, Miklósi, & Csányi, 2003), and in research that looks at a canine's ability to understand social communication of humans, without the humans realizing that's what is happening (Sümegi, Kis, Miklósi, Topál, 2014). Canines have a fluid enough understanding of social systems to be able to adapt to changing situations. In a study investigating canine comprehension of human social cues done with a robot, researchers found that the dog was still able to locate hidden food based on the machine's social cues (Gergely, Abdai, Petró, Koszatolányi, & Topál, 2015). The ability of the dog to understand social cues is a huge evolutionary advantage developed for life with humans.

Dogs have many other evolutionary advantages to living with humans compared to their undomesticated cousin, the wolf. In one such study, dogs were tested against apes in their abilities to correctly identify the location of hidden food (Bräuer et al., 2006). The food was hidden in full view of the subjects, and the location with the food was indicated to in various ways by the researcher (e.g., social cues such as pointing or gazing, or causal cues such as being placed under an uneven board). They found that when the food was referred to by the researcher using a social cue, the dog rather than the ape was significantly more apt to finding its location. This suggests that dogs have evolved in their interactions with humans to be more cognitively aware of the social cues humans use. On the converse side, the apes were much better at finding

the location of the hidden food using causal clues, such as a piece of food being hidden underneath a board of wood, causing the board to be lopsided. This is something that the canines failed at. This suggests that the connection between dogs and humans has inhibited dogs' ability to problem solve. Rather, dogs have become accustomed to social cues from humans, but unaccustomed to the causal cues they may have once depended on the in the wild.

A recent study by Udell (2015) directly comparing dogs and wolves suggests that the domestication process has altered the problem solving abilities of dogs. In the study, wolves and dogs were both motivated to open a puzzle box to find the food inside. Yet, only 5% of the dogs could open the box, and 80% of the wolves were able to get the box open. The researchers concluded that the domestic dogs were less motivated to open the box because of prior knowledge that a human will do it for them; whereas the wolves were accustomed to finding food for themselves, and as a result the wolves worked at opening the box more.

Not only can dogs correctly identify and respond to social cues, but they can also imitate human actions to gain a desired reaction. In a study by Kubinyi et al. (2003), dogs were put into a room with a lever system that distributed treats. In one condition, dogs watched their owners go up to a box with a lever, press the lever and receive a treat. In the other condition, the dogs did not view any action with the lever system, but were just left in the room to figure it out. The dogs in the condition where their owners touched the lever repeated the same movement sooner, and more often than the dogs blind to their owner touching the lever.

Intergroup Differences in Dogs

Breed differences. Given the wide variety of dog breeds available, and the large amount of selective breeding that went into creating them, it is no wonder that there are physiological and behavioral differences. A study looking at the olfactory abilities of three different breeds of

dogs—a Pug, a German Shepherd, and a Greyhound—found that despite preconceived ideas that the German Shepherds would have the best sense of smell, Pugs actually performed more accurately and they were able to smell weaker scents more often (Hall et al., 2015). These findings suggest that different breeds of dogs have developed different olfactory detection levels, at least in the case of the Pug, different breathing techniques to help them pick up scents more effectively.

Behaviorally, breed groups differ in their overall personality traits. In a study using a shy-boldness continuum to rate dog breeds, it was found that guard dog breeds (e.g., Doberman Pinscher, Giant Schnauzer, and Mastiffs) were seen as the boldest of the breeds (Starling, Branson, Thomson, & McGreevy, 2013). This means that these breeds are seen as curious, fearless, and playful. The shyest breed group was the companion dogs (e.g., smaller breeds like Toy Poodles, Bichons, Pugs). Shyness was assessed as being an absence of boldness traits. Through the process of selective breeding, different breed groups have clearly developed different personalities to best suit their purpose. Therefore, these breeds have been evolutionarily designed to fit the job that they were bred for.

Evidence suggests that smaller breeds are more disobedient, have higher energy, are more aggressive, and are more anxious than larger breeds of dogs (Arhant, Bubna-Littitz, Bartels, Futschik, & Troxler, 2010). Research suggests that, when comparing large and small breeds of dogs, small dogs are viewed by owners to be more disobedient. Yet, owners also rated themselves as being less consistent with training and treatment as compared to owners with larger dogs. Therefore, the lower levels of obedience seen with smaller dogs is best accounted for by the lower emphasis of training and obedience placed on smaller dogs by the owner. The higher levels of aggressive behavior likely came about because of the dog owners tolerating the

behavior through time, but smaller dogs might have evolved to carry a genetic predisposition for aggression as well.

Shelter dogs and owned dogs. An estimated four million dogs make it into an animal shelter every year, with approximately two million being adopted into homes (Thorn, Templeton, Van Winkle, & Castillo, 2006). In situations where a dog is in a local animal shelter, the dogs in the shelter experience loud barking, small spaces, and an aroused state of awareness at all times. Shelter dogs typically receive less socialization and more stress due to noise, as compared to dogs in a household. Due to this, dogs that have been raised in a home as compared to in a shelter often react to situations differently. The potential differences in reactions of owned dogs as compared to shelter dogs are a motivating factor for the current research. Research conducted by Barrera, Jakovcevic, Elgier, Mustaca, and Bentosela (2010) examined if shelter dogs and pet dogs react to a stranger differently. Their research found that shelter dogs displayed more fearful behavior—tail between legs, ears back and down, hunched—than owneddogs. Despite being fearful, the shelter dogs also remained in closer proximity to the stranger. The researchers suggest that the differences in behavior could be due to the lack of attention and interaction the shelter dogs have with humans.

In addition, research has shown that shelter dogs are less skilled with identifying human social cues than pet dogs. Duranton and Gaunet (2016) found that pet dogs outperform shelter dogs when it comes to pointing gestures and estimating where a human is gazing at. In turn, the shelter dogs are more concerned with gazing at humans and interacting with humans as opposed to paying attention to social cues. Again, this is most likely due to the lack of interaction that the dogs get in a shelter environment, where attention is more important to them than responding to

social cues. Dogs in a shelter are typically assessed on various personality traits prior to becoming available for adoption; the most important of these traits to assess is aggression.

Aggression is best defined as "overt behavior or intent by an organism to injure or otherwise inflict noxious stimulation towards another organism" (Bollen & Horowitz, 2007, p. 121). Many shelters assess the dog on their likelihood of displaying aggressive behavior in the future towards humans. Studies have found that the best predictor of future aggressiveness in the canines was past aggressiveness. Furthermore, a dog is more likely to display aggressive behavior when they are feeling threatened, which dogs can assess through human facial expressions (Somppi, Törnqvist, Kujala, Hänninen, Krause, & Vainio, 2016). Through the use of eye tracking equipment, researchers have been able to identify that dogs can differentiate among facial expressions and adjust their behavior according to what the situation needs. They have found that dogs' gaze is directed at the eyes, midface and mouth of a person. If the expression on a face was a negative expression, they found that the dogs reacted with an avoidance response as compared to if it was a positive expression. Another important way that researchers take a look into the mind of a canine is through the use of physiological measures, such as heart rate variability.

Emotional States on Heart Rate Variability

Heart rate variability (HRV) is the variation of the time between heart beats, measured by the beat to beat interval. This was first observed in canines in 1847 by Ludwig (Ludwig, 1847); he noticed that when a dog drew in a breath of air, its heart beat increased and when it exhaled its heart rate decreased (Berntson et al., 1997). This phenomenon is called Respiratory Sinus Arrhythmia. This is common among all dogs (and humans), and causes variation in the RR

interval (the time between corresponding to the R point on the QRS complex of an electrocardiogram wave) (Tilley & Smith, 2011).

HRV is often divided into three parts: high frequency (HF) which reflects mostly parasympathetic influence on the heart. Low frequency (LF) reflects both sympathetic and parasympathetic influence, and very low frequency (VLF) which reflects various reflexes that help maintain homeostasis. Changes in HF and LF power are observed under different conditions. LF has been shown to increase while standing or during mental stress, while HF has been shown to increase during controlled respiration and decrease during mental stress or increased workload (Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology, 1996).

In humans, HRV changes depending upon the person's emotional state (Lane, McRae, Reiman, Chen, Ahern, & Thayer, 2009). In a study by Lane et al. (2009), they induced positive and negative emotional states and recorded the HRV of the participants during that time. Their research found that HF-HRV was lower during the emotional states as opposed to when the participant was neutral. This suggests that there is a connection between the emotional state of an individual and the activation of cardiac response. Further research has found that situational awareness (how aware one is of the circumstances around them) has a connection to HRV (Thayer, Hansen, Saus-Rose, & Johnson, 2009). More specifically, they found that groups with an increased situational awareness had a reduction in HF-HRV during the task they were asked to do, and an increase in HF-HRV when in recovery after the task. However, the group with low situational awareness did not have any differences in their HRV during and after the tasks. This research suggests that an increase in mental workload or stress can reduce HF-HRV.

In addition, Thayer, Ahs, Fredrikson, Sollers III, and Wager (2012) propose that there is a direct connection between HRV and the amygdala (part of the emotional center of the brain). The amygdala is active during threatening situations, or times of high stress. They also state that HRV is also a useful indicator of stress and mental workload. Due to this, Thayer et al. (2012) propose that there is a strong connection between neural structures (in particular, the amygdala) and HRV. Thayer et al. (2012) state that HF-HRV is a direct reflection of parasympathetic nervous system activity and that a decrease in HF-HRV indicates a decrease in the activity of the parasympathetic nervous system. This finding supports Thayer et al. (2009) which show that stress and mental workload decrease HF-HRV.

Lastly, a study using music to induce emotional states found that individuals who listened to either positive or negative music had variations in their heart rate (HR) and HRV according to the music type (Riganello, Candelieri, Quintieri, & Dolce, 2010). They found that individuals who listened to positive music had a decrease in HR, whereas individuals who listened to negative music had an increase in HR. In addition, they found that they could match up the participants self-reported views on positive or negative music with their LF-HRV.

Research on canines and HRV is quite limited: however, research has been conducted investigating HR and HRV in dogs performing physical and mental tasks (Maros, Dóka, & Miklósi, 2008). The researchers found that a dog's HR changed depending on the amount of physical activity that they performed, whereas the HRV remained relatively consistent regardless of physical activity. They tested this by having the dogs sit, stand, lie down, and walk while recording their heart data. They found that a dog's HR was highest while walking, lowest while lying down, and did not change between sitting and standing. Conversely, HRV changed depending on the situation that the dog was put into. For example, if the dog was orientated

towards its favorite toy, but not allowed to play with it, their HRV increased. In addition, HRV also increased when petting the dog by a stranger stopped. Meanwhile, the heart rate remained consistent during the mental tasks (Maros, Dóka, & Miklósi, 2008). This implies that HR is more closely connected with the physical strain, whereas HRV is more connected with emotional strain or mental workload.

More recently, research has looked at HRV in canines during emotional states. Researchers tested beagles HRV for different stimuli (Zupan, Buckas, Altimiras, & Keeling, 2016). They tested the dogs with a low reward food and a high reward food, as well as a familiar person and an unfamiliar person. The dogs first saw the stimulus (person or food), were blocked from view of it, and then allowed to go get their reward. When the dogs were viewing the high reward food or the familiar person, the dogs had a decrease in HF-HRV from the viewing phase of the experiment to the reward phase of the experiment. This change in HF-HRV was associated with a positive mental state or an increased workload. Therefore, the research suggests that HF-HRV decreases for positive emotional valence (such as receiving a reward), and an increase is associated with emotional arousal or an increase in mental workload (Zupan et al., 2016). This research is contradictory to human research that has been conducted on humans with HF-HRV (Thayer et al., 2009; Thayer et al., 2012). Therefore, Zupan et al.'s (2016) research may not be a true indicator of how HF-HRV works in canines. Rather, further research on canines reflects HF-HRV as being similar to that of humans.

Additional research by Kuhne, Höβler, and Struwe (2014) examined HR and HF-HRV while the dogs were petted in different places and positions, and by a familiar and an unfamiliar person. Their research found that when a dog was being petted by a familiar person, there was an increase in HR while HF-HRV decreased slightly. When the individual petting the dog was an

unfamiliar person, there was a slight decrease in HR and a decrease in HF-HRV. Furthermore, their results showed that dogs were more likely to display "appeasement gestures" (blinking, closing eyes, looking elsewhere, laying down, rolling over, lifting a paw) when there was an increase in HR and a decrease in HF-HRV. In other words, the dogs were more likely to display appeasement behavior when they were with a familiar rather than an unfamiliar person. Their results show that the familiarity that the dogs have with the person and where they are being petted influence their cardiac activity. These results suggest that when a dog is relaxed and displaying appeasement behavior, their HR increases whilst their HF-HRV decreases slightly. In the research, the dogs are slightly more uncomfortable when being petted by an unfamiliar person, and as a result both their HR and HF-HRV decrease significantly. This research seems to contradict what Zupan et al. (2016) proposed to be the connection between emotional state and cardiac activity, but it follows what most human research suggests (Thayer et al., 2009; Thayer et al., 2012).

Jealousy in Humans

Jealousy happens when "the perception that another (even if only imaginary) poses a threat to an important relationship, and differs from other types of rejection in that one's interpersonal loss is another's gain" (Harmon-Jones, Peterson, & Harris, 2009, p. 113). Jealousy research based off this definition has primarily focused on humans. Similarities have been made between humans and canines (cognitive function, differing personalities); given the lack of research involving jealousy in dogs, human jealousy research is the only comparable research to canine jealousy available. Although, a key difference between human jealousy and canine jealousy would be the definition of jealousy itself, such that human jealousy is more concerned

with the relationship aspect (Harmon-Jones, Peterson, & Harris, 2009, p. 113; Harris & Prouvost, 2014), and canine jealousy may be more concerned with resource distribution (Horowitz, 2012).

Researchers have investigated what brain regions are active during a jealousy episode in humans. Research by Harmon-Jones et al. (2009) suggests that jealousy in humans is associated with greater left frontal lobe activation. The participants in this study experienced rejection from both men and women. When a male was the one rejecting the participant, the activation in the left frontal lobe was also associated with feelings of anxiety. When the female was the one rejecting the participant, the participant experienced greater feelings of anger regardless of participant gender.

A study by Kelley et al. (2015) suggests that if the left frontal lobe is activated in humans before introduction of a jealousy provoking stimulus, the reaction is an increased amount of jealousy. During this research, participants received transcranial direct-current stimulation (tDCS) over the left frontal lobe, in order to increase activity in that specific area. They found that a relative increase in activity using tDCS over the left frontal lobe increased the amount of jealousy that participants displayed as opposed to when activity was increased over the right frontal lobe.

In addition to these neurological measures, physiological signs in humans have been measured through increases in electrodermal activity (EDA), pulse rate (PR), and electromyographic activity (EMG) (Buss, Larsen, Westen, & Semmelroth, 1992). More recently, human emotional responses have been measured using startle eye blink response as an indicator of jealousy (Baschnagel & Edlund, 2016).

Research looking at physiological reactions to jealousy provoking stimuli began with Buss et al. (1992). They asked participants to think of two scenarios where a partner became

involved with someone else. The researchers recorded EDA, PR, and EMG (in this case, brow contraction) of all participants during the study. They found that there was an increase in the amount of EDA when exposed to jealousy inducing stimuli, and an increase in PR. The EMG recordings did not reach significance, but they did show that there was an increase.

More recently, research by Baschnagel and Edlund (2016) demonstrated that startle eye blink response, a measure more closely related to emotional responses, can be used as another physiological measure of jealousy. In their study, the researchers looked at sex differences in jealousy using self-report methods, startle eye blink, EDA, HR, and EMG (in this case, facial) responses. They found a sex difference in jealousy with physiological methods, in particular with the startle eye blink response. Their results show that men have a much more pronounced startle eye blink response to both sexual and emotional jealousy as compared to women. In other measures, very few physiological differences of jealousy were found between men and women.

Sagarin, Martin, Coutinho, Edlund, Patel, Skowronski, and Zengel (2012) found through a meta-analysis across many different research experiments that anger, jealousy, and distress were the most common responses of to a jealousy provoking stimuli or situation in both men and women. Furthermore, jealousy has been listed as one of the top motives for inter-spousal abuse, suggesting that the physiological responses and psychological responses to jealousy can lead to aggressive acts (Harris, 2002). However, despite the plethora of research looking at humans, there is limited research looking at jealousy in canines.

Jealousy-like Behaviors in Animals

The only study to date on dogs and jealousy was conducted by Harris and Prouvost (2014). They defined jealousy as an interloper threatening an important relationship in a social triangle (based on the definition Harris had used in humans). However, there is no reason to

believe that this definition needs to extend to dogs. As such, as detailed later, jealousy in dogs may be better defined as an individual canine being fiercely protective or vigilant of certain rights, possessions, and equality.

Fairness (which may relate to jealousy), or the interest in one's rights and equality, has been studied in both non-human primates and in canines (Bräuer & Hanus, 2012). Bräuer and Hanus (2012) wrote a meta-analysis on fairness with great apes and capuchin monkeys. In one trial of an experiment they described, the researchers placed monkeys in two adjacent rooms with full visual and auditory access to each other. The experimenter gave each monkey a piece of food in full view of each other, a low quality food (carrots) to one and a high quality food (grapes) to another. Some of the monkeys displayed frustration with receiving a low quality food. The frustration that was revealed with the low quality food was often accompanied with an increased distance between the cages that they monkeys were housed in. If there was no way for a monkey to access the other monkey's food, they became more agitated than if they could swipe the food from the other monkey. The monkey that received the low quality food as a reward was more likely to reject said reward. In this study, the researchers were calling this fairness, but it can be viewed as extremely similar to jealousy.

A study by Horowitz (2012) examined dog's reactions to unequal treatment. She examined whether dogs would react differently when one dog (the experimental dog) received a higher or lower reward than another dog (control dog). The experimental dog always received the same reward, but the control dog's reward varied. She then measured how the experimental dog reacted to the unequal treatment. In her research, both of the dogs and handlers approached either "fair" or "unfair" (over rewarding or under rewarding) trainers. The trainers repeatedly asked the dogs to sit, and then rewarded them. The fair trainers rewarded both the experimental

and control dog equally. The unfair trainers rewarded the control dog with either more or less treats than the experimental dog. After the initial training, the experimental dogs were left to choose a trainer which was determined by which trainer they approached. Horowitz (2012) found that the experimental dogs who had watched the control dogs being rewarded with the "over rewarding" trainer chose them more often compared to the "fair" trainer. Yet, the experimental dogs who had watched control dogs with the "under rewarding" trainer showed no preference for trainers.

Further research on canines has shown that dogs are averse to unequal treatment for equal work (Range, Horn, Viranyi, & Huber, 2008). In a study looking at canine's reactions to different rewards for the same work, which was "giving the paw", researchers studied dogs reactions to different food rewards. They found that when dogs were tested individually, even though they did not refuse a low-value reward, dogs did take longer to respond when a low value reward was involved. When the researchers stopped rewarding "giving the paw", the dogs stopped participating in the trials when they were not being rewarded. The researchers also examined if dogs in pairs reacted differently to single dogs. The research was conducted in a social situation where two dogs are both performing "giving the paw". Unequal treatment was given to one of the dogs, and the dog receiving unfair treatment (no reward) often refused to complete the task quickly, or at all. Furthermore, the dog that did not receive a reward showed an increase in stress during trials where there was no reward present. These results suggest that, socially, dogs are cognizant to the conditions of other canines performing the same trick and therefore are sensitive when they are given unequal treatment.

Harris and Prouvost (2014) investigated the reactions of dogs to jealousy provoking stimuli and they found that dogs are more likely to react in a jealous manner—for example

through barking, whining, or pushing away of the offender—if the object that is causing the jealousy looked like another dog. In particular, they found that dogs reacted with increased aggression (e.g., biting or snapping at the object, lip curling), increased attention seeking behaviors (e.g., pushing the owner, getting between the owner and rival, vocalizations), and increased interest (e.g., head turned toward rival, head and body turned towards rival) towards the rival (stuffed plush dog) in the study. When the dogs were exposed to the control condition (i.e., reading a book), they treated the object with some interest, or completely ignored it.

Of note, Harris and Prouvost's research took place in each owner's home, where the dog could have been reacting territorially (Pérez-Guisado & Muñoz-Serrano, 2009). In addition, the person causing the jealousy through interaction with the stimuli was the owner. The owner would sit down with their dogs, all under the weight of 35 pounds, and give special attention to one of three objects. The owner would either read a book aloud, give attention to a Jack-O-Lantern, or they would give attention to a plush stuffed animal that looked like a dog. The researchers found that dogs reacted with significantly greater amounts of aggression, significantly more attention seeking behaviors and showed increased interest and gazing in the plush stuffed dog condition than to any other condition. They did not examine if there were sex differences in jealousy (N=36, 18 male and 18 female). To date, there is no research recording if there are differences in jealous reactions between canines of difference sexes.

The Current Research

Definition of Jealousy. Harris and Prouvost defined jealousy as an interloper threatening an important relationship in a social triangle. Although, this definition of jealousy is appropriate for human relational jealousy, it could be argued that it is not appropriate for animal jealousy. This is because, as shown by Bräuer and Hanus (2012), animals are more concerned with

resources than they are with relationships. In one of the study manipulations, the monkeys had the option of receiving more reward than their partner, receiving less, or receiving equal amounts. Overwhelmingly, the monkeys preferred receiving the food from the researcher where they received more food than their partner in an adjacent cage (where the relationship the researcher had with the monkeys was not disclosed, and the relationship between monkeys can only be assumed to be in living conditions) (Bräuer & Hanus, 2012). This is just one example that the monkeys were more concerned about their own resources than about the relationship they had with the other monkey. Additionally, canines showed the same resources over relationship mentality when they chose the over rewarding trainer as opposed to the fair trainer (Horowitz, 2012). In Horowitz's (2012) experiment, there was no previous relationship between the dogs and the trainer, and the only reinforcement relationship that was developed was during the course of the experiment.

Harris and Prouvost (2014) thought that the relationship between the dog and the owner was essential for a jealousy-like reaction in the canine. The term relationship needs to be defined in order to fully understand and appreciate what they had thought. For animals, and canines in particular, a relationship would be any history of reinforcement that the dogs receive from a human. For owners, there is a long history of reinforcing behaviors in the canines, whether they be beneficial or not. For strangers to the dog, there is no relationship because there is no history of reinforcement between the human and the dog.

Therefore, for the purpose of working with canines, the operational of definition of jealousy will be defined as: *an individual being fiercely protective or vigilant of certain rights, possessions, and equality.* This is a stronger and more appropriate definition of jealousy in terms of animal behaviors, because animals are not reacting to jealousy in the same manner as humans.

In addition, this definition leaves out the necessity for the relationship between the human and the animal. For the current study, this definition of jealousy will be operationalized through the presence of behaviors such as interest, aggression, attention seeking, and over arousal. This definition is supported in the research by Bräuer and Hanus (2012) with fairness studies in monkeys, equality and fairness studies by Horowitz (2012) and by Range et al. (2008) in canines. Although neither of these studies explicitly studied jealousy in a relational manner, jealousy with resources is essentially the same as fairness. In each of these studies, the researcher does not have an established relationship with the animal, and in each study the animals are reacting to the inequality and unfairness of resource distribution. Therefore, it can be concluded that jealousy in animals is equivalent to animals reacting to unequal treatment or fairness due to resource distribution.

Harris and Prouvost (2014) only examine behavioral reactions during their research, not physiological reactions. Behavioral reactions are strong indicators of emotion, but it would be better if there were other measures to track the physiological changes in the dogs during the trials. Research has suggested that, in canines, HR is affected by physical activity whereas HRV is affected by psychological activity (Kortekaas et al., 2013). With this information, recording data on HRV during a mental or emotional task is necessary. The current study recorded RR intervals to see if there were any changes between the various stimuli, either the neutral stimulus or the jealousy provoking stimulus.

For the current research, references to jealousy are relating to the current definition (fiercely protective or vigilant of certain rights, possessions, and equality), not the definition that Harris and Prouvost (2014) use (an interloper threatening an important relationship in a social triangle). The current definition encompasses the type of jealousy displayed by animals over

resources (Bräuer & Hanus, 2012; Horowitz, 2012; Range et al., 2008), as opposed to the type of jealousy that is displayed by humans (Sagarin et al., 2012; Buss et al., 1992; Harmon-Jones et al., 2009; Baschnagel & Edlund, 2016).

Research Questions and Predictions.

Operational Change 1. Harris and Prouvost's (2014) research was the first of its kind looking at jealousy in canines. Yet, there are some changes to the initial research that are required. First, the location of their research varied with each dog. The goal of this manipulation was to ensure that each dog was comfortable in the testing environment. This may have inadvertently influenced the reaction of the dog because the researcher was intruding into the dog's territory, or any defendable space that the dog sees as its own (Pérez-Guisado & Muñoz-Serrano, 2009). This may have heightened aggressive responses seen in the dogs. To assess this possibility in the current research, the same testing location was used for each dog in the shelter, but the testing location of the owned dogs was still conducted in each owner's home.

Operational Change 2. Harris and Prouvost (2014) looked for behaviors they believe a dog would display if it were jealous based on their definition. They drew their conclusions of a dog's behavioral reactions to jealousy from research on infants and their reactions in a jealous manner. Despite the similarities between humans and canines (shared evolutionary history, similar cognitive decline, etc.), research does not support that dogs would have the same behavioral reactions to a situation as an infant (aggression, attention seeking behavior, interest, over arousal). In reality, their results showed that most dogs became aggressive towards a possible intruder, become interested in their owner's interaction with this intruder or rival, and whined when a rival was receiving attention that they were not. These could all be signs of territorial behavior, but not jealousy as operationalized by Harris and Prouvost (2014). It would

not be jealousy as defined by Harris and Prouvost (2014) because the relationship between the dog and the human is not necessary to illicit these reactions, as shown in fairness research by Bräuer and Hanus (2012), Horowitz (2012), and Range et al. (2008) where the animals reacted negatively despite having no close relationship with the trainer or researcher. Therefore, the operational change here would be how the reactions of the dogs are interpreted, whether it is looked at as human-relational jealousy or as resources jealousy.

Operational Change 3. Next, in the Harris and Prouvost (2014) study, the person who induced the jealousy behaviors onto the dog was the dog's owner. But, due to the situation, the dog could have reacted with increased jealousy-like behaviors because of the dog already having an intruder in their home. Furthermore, as shown by Arhant et al. (2010), owner's reactions may influence the behavior of the dog; unintentional social cues from the owners may have influenced the dogs' reactions to the stimuli. In the current study, a researcher conducted the majority of the trials (Jack-O-Lantern, and stuffed dog), except for the owned dog group where the owner also conducted a neutral condition and a provoking condition. This is included as a direct replication of Harris and Prouvost (2014).

Operational Change 4. Harris and Prouvost (2014) based all of their research solely on behavioral reactions from the dogs. In order to truly understand what is occurring with the dogs, it would be best to study both behavioral and physiological reactions. Research by Thayer et al. (2009; 2012) suggests that stress and mental workload is connected to cardiac activity. In addition, research by Kuhne, Höβler, and Struwe (2014) suggest that stress and mental workload in canines is also associated with cardiac activity, particularly HF-HRV. In the current study, the dogs' HRV was analyzed to identify any changes in cardiac activity that could be associated with an emotional response during the trials.

Research Question 1. Harris and Prouvost (2014) research only examined dogs that had owners. This was due to the nature in which they defined jealousy. There are known differences between shelter dogs and dogs with owners (Barrera et al., 2010). Therefore, it was prudent to research both groups, shelter dogs and owned dogs. In order to properly do this, the shelter dogs experienced two conditions (researcher with the plush dog and the Jack-O-Lantern), whereas the shelter dogs experienced four conditions (researcher and owners each with the plush dog and Jack-O-Lantern).

In Harris and Prouvost (2004), a jealousy provoking stimulus was only conducted on dogs with owners. The owner was the one paying attention to the stuffed dog in front of their dog. Research suggests that home dogs will react less aggressively and less fearful in meeting strangers than shelter dogs (Barrera et al., 2010). It was hypothesized that the shelter dogs would react with decreased HF-HRV (Kuhne, Höβler, & Struwe, 2014). From a behavioral aspect, it was expected that the shelter dogs would react with increased aggression, increased attention seeking behaviors, increased over arousal, and increased interest, but it is expected that their reactions would be less than those of the owned dogs (Harris & Prouvost, 2014)

Research Question 2. The current study investigated the reactions of dogs to one neutral stimulus and one jealousy provoking stimulus. The neutral stimulus was similar to Harris and Prouvost's neutral stimulus (2014), where the researcher was playing with a Jack-O-Lantern (in the dogs with owners group, the owners also did this condition). Based on the work of Harris and Prouvost (2014), it was predicted that the neutral condition would not provoke any type of jealous reaction from the canine in either the shelter dogs or in the owned dogs.

The jealousy provoking stimulus was the researcher playing with a dog (plush stuffed dog) as if it were a real dog. As Harris and Prouvost's (2014) research suggests, this should

evoke some response from the dog (such as interest, aggression, or attention seeking). Further research also suggests that dogs will treat a fake dog as if it were a real dog (Shabelansky, Dowling-Guyer, Quist, D'Arpino, & McCobb, 2015). From a behavioral aspect, it is expected that the dog reacted with the most aggression, attention seeking behaviors, interest, and over arousal (Barrera et al., 2010; Harris & Prouvost, 2014). It was hypothesized that the dogs would react with decreased HF-HRV. This was proposed because of previous research indicating a decrease in HF-HRV with an increased mental load (Thayer et al., 2009; Thayer et al., 2012), and a decrease in HF-HRV during a potentially stressful event (Kuhne, Höβler, & Struwe, 2014). Although the research on cardiac responses is conflicting, with some research proposing an increase in HF-HRV and some proposing a decrease, it seems that a decrease in HF-HRV is the best option for the current study. Given that HF-HRV is an indicator of the parasympathetic nervous system on the heart, a decrease in the parasympathetic function of the autonomic nervous system would indicate an increase activation of the sympathetic nervous system. Given the previous research by Harris and Prouvost (2014) where they found that the neutral stimulus acted as a control, in this study the Jack-O-Lantern will again act as a control and a baseline comparison for the plush dog stimulus.

Research Question 3. All of the dogs in the study by Harris and Prouvost (2014) would be considered to be part of the small breed family. Smaller breeds are known for being shyer (Starling et al., 2013), and they have been shown to be less obedient and more aggressive (Arhant et al., 2010), all of which may have influenced the results obtained by Harris and Provoust (2014). It was expected that smaller breeds to react to the two different jealousy conditions with greater reactions (increased aggression, attention seeking behavior, interest, and over arousal) than large breed dogs (Arhant et al., 2010; Starling et al., 2013).

Research Question 4. In addition, Harris and Prouvost (2014) collected data on the differences in sex of the dogs, but never reported if there were any sex differences related to their jealous reactions. Harris and Prouvost (2014) collected data on sex, yet they did not investigate whether a sex was a factor in the dog's reactions to a jealousy provoking stimulus. Previous research has studied sex differences in canines and has seen significant differences in sex but not in castration status (Pérez-Guisado & Muñoz-Serrano, 2009). It is expected that there would be differences in behavior due to the sex of the dog, with male dogs having more reactions to the jealousy provoking stimulus than female dogs, but it was not expected for there to be differences in reactions based on the dogs being neutered or not (Pérez-Guisado & Muñoz-Serrano, 2009).

Exploratory Analysis. Dogs taken into shelters are all rated on their behavior (Appendix A). It was necessary to explore whether the reactions of the canines during the trials corresponds in any way to the ratings they received upon intake into the shelter. Specifically, their levels of arousal with toys, reaction to strangers, and how they react to other dogs/on leash greetings with other dogs, and each dogs' length of time in the shelter was examined. Their level of arousal with toys was necessary to know due to the stimuli both being inanimate objects, and potentially viewed as toys. This was operationally defined as how aroused they became when playing, and it was rated from "Nice level of play with toys, allows handler to take toys", to "Possessive of toy, explain". Their reaction to strangers was necessary because of the researcher being a stranger to all of the dogs in the trials. This was operationally defined by how the dog reacted when a stranger walked into the room, and was rated from "Dog is eager and excited to meet stranger, is friendly upon solicitation", to "Dog alarm barks, growls, snarls, lunges—not safe to allow approach". How they react to other dogs in greeting is needed due to the plush dog in the research, and lastly, the length of time in the shelter to see if their time affects their responses.

Specifically, the question that is being examined here is: are there personality differences in canines that predispose them to react a certain way to either stimulus? In addition, this section also examined if there are differences in reactions depending on the dog's age, and if there are differences in reactions depending upon how long the owner or the shelter has had the dog for.

Method

Subjects

Shelter dogs. The subjects were 20 dogs from western New York State in a local non-profit animal shelter (number of subjects was determined by a .8 level of power, Faul, Erdfelder, Lang, & Buchner, 2007). The dogs background demographics and ages varied, as well as their breeds. Large breeds were dogs who at full grown, the average size of the breed by AKC standards was over 35 lbs. (N=10). Small breeds were dogs who at full grown, the average size of the breed by AKC standards was under 35 lbs. (N=10). The ages, sex, neutered or non-neutered, breed and behavioral assessment (see Appendix A) were recorded on each dog (Table 1). The length of time since neutering was recorded, as research shows that testosterone will remain in a dog approximately six weeks after surgery (Millburn, 2016). All of the dogs were adults (>1yr.) (M=6.05, SD=4.59), and from there the dogs were categorized as adults (ages 1-6) or senior dogs (7 and above). For the dogs, the health of the dog at the time of testing, their duration of stay in the shelter and, if possible, how the dogs were acquired was recorded (Appendix C).

Owned dogs. The subjects were 21 dogs from owner's homes. Location of the dog's ranged from owner's homes in western New York to central Pennsylvania. Their ages and background demographics, and breeds varied (large breed N=11, or small breeds N=10). Again, large breeds were dogs who at full grown, the average size of the breed by AKC standards was

over 35 lbs. (N=10) and small breeds were dogs who at full grown, the average size of the breed by AKC standards was under 35 lbs. (N=10). Ages, sex, neutered or non-neutered, breed and behavioral assessment (see Appendix A) were recorded on each dog (none of the owned dogs were non-neutered). Behavioral assessment was recorded on a modified version of the shelter's behavioral assessment form (Appendix B). All of the dogs were adults (>1yr.) (*M*=6.69, *SD*=3.49), and from there the dogs were categorized as adults (ages 1-6) or senior dogs (7 and above). For the dogs, the health of the dog at the time of testing, how long the owner had owned them, and how the owner came to own them was recorded (Appendix C).

Materials

In order to do this research, there was a plastic Jack-O-Lantern used for the neutral condition and a stuffed dog (Melissa and Doug Rottweiler Plush) measuring 31 inches long, 25 inches high, and 11.7 inches wide, was used for the jealousy condition. Three martingale collars and a sturdy rope leash were used during the trials. To monitor physiological changes during the trials, a heart monitor (Polar H7, see below) electrode gel, and an electric clipper were used. The dogs needed to have a small patch of fur shaved off on its chest by the researcher to accommodate the heart monitor. This procedure did not take longer than 10 minutes.

Procedure for Shelter Dogs

All trials started at the same time of day (approximately 11 am) with the same amount of time between feeding (approximately 7 am) and the start of the trial to control for differences in reactions due to hunger. The experimental procedure began with the researcher (wearing a laboratory coat) getting the dog from its kennel and fitting it with a martingale collar (Figure 1) and heart monitor (worn as a strap around their torso like a dog harness) (Figure 2). At this time, the dogs were held while the researcher shaved a patch of fur on their chests. All dogs had a

patch of fur shaved to ensure a good connection for the heart monitor. In addition, electrode gel was applied to the heart monitor to ensure a good connection between the dog's skin and the metal electrodes. The dog was then hooked to a rope leash and taken out to the yard for a walk and to be played with for about 10 minutes (to allow the dog to work out its excitement at being taken out of its kennel). Next, the researcher walked the dog on its leash to a multipurpose room located within the shelter. The room was used as the trial room, and one of the two conditions (Jack-O-Lantern or plush dog) was set up. The researcher utilized a wall hook for the leash and hooked the dog onto the wall hook where it was just out of reach of the researcher and the stimulus. At the far end of the room, a video camera was set up on a tripod and pointed in the direction of the interaction. The trial condition determined which stimulus was present in the room (plush dog or Jack-O-Lantern). This stimulus was present in the center of the room, in view of both the dog and the video camera (Figure 3).

At the beginning of each trial, the researcher turned on the video camera, started a timer for three minutes for the interaction, and went over to the stimulus. The researcher then played with and/or paid attention to the stimulus for the duration of the timed period (stuffed dog or Jack-O-Lantern) (script in Appendix D). After the interaction of the dog and the stimulus, a post-interaction period (5 minutes) was allowed where the dog was able to freely walk around the room and directly interact with the plush dog, Jack-O-Lantern, or the researcher (this was not videotaped or coded for). During this period, the researcher observed that the dogs showed interest in the plush dog through sniffing the legs, torso, and anal region. The majority of the dogs did not display signs of aggression, attention seeking, or over arousal behaviors, although one intact male did continue to display over arousal behaviors. As for the pumpkin condition, the dogs did not show signs of interest, aggression, attention seeking, or over arousal behaviors.

Then, the researcher commenced with whatever trial had not been run yet on that dog. Once both conditions were completed (5 minutes between conditions which was used as the post-interaction period), the researcher stood up, stopped the video camera, and took the dog on its leash back down the hallways to its kennel. Once in the kennel, the researcher took off the martingale collar and the heart monitor in order to use them on another subject.

In a single day of testing, each dog experienced both conditions. The order of conditions was counterbalanced for each dog on each day. The procedure was exactly the same before and during each condition. There was approximately five minutes between each condition before the next condition started. Once the dog completed both conditions for the day, the researcher worked on specified training techniques (per the shelter) for about 10 minutes.

Procedure for Owned Dogs

All trials were scheduled with the owner so they started at the same time of day (approximately 11 am). Furthermore, the owner was asked the feeding schedule of their dog, and, if necessary, they were instructed on when to feed the dog in the morning (7 am), so that there was the same amount of time between feeding and the start of the trial (identical to the length of time between feeding and testing in the shelter dogs). The researcher met the owners at their homes approximately half an hour before the start of the trials. The owners were required to read and sign a consent form for their dog to participate in the research (Appendix E). During the time that the owner was reading and answering paperwork, the researcher spent time with the dog playing and setting up the conditions. This way, the dog was used to the researcher's presence at the house in the same way that walking and playing with the shelter dogs ensured that they were calm and used to the researcher's presence at the shelter. The experimental procedure began with the researcher (wearing a laboratory coat) fitting the dog with a martingale

collar (Figure 1) and heart monitor (worn as a trap around their torso like a dog harness) (Figure 2). Just like in the shelter dog trials, all dogs had a patch of fur shaved to ensure a good connection for the heart monitor. The procedure continued the same as the shelter dog condition, using the same script (Appendix D). Instead of a multipurpose room being used, it was a room in which the dog and researcher could be alone and isolated for the conditions. If the owner's had multiple dogs, their other dogs were isolated in a separate area to ensure they would not be an influence. Since the room was in the owner's home, the dog was not hooked up to a wall hook for the trial, but instead was tied to a piece of furniture (table leg, chair) to simulate the shelter condition. After each condition, there was a 5 minute post-interaction period where the dog could walk freely around the room and interact with the researcher, the owner, the Jack-O-Lantern, or the plush dog (this was not videotaped or coded for). During this period, researcher observed that the dogs showed interest in the plush dog through sniffing the legs, torso, and anal region, but did not display signs of aggression, attention seeking, or over arousal behaviors. As for the pumpkin condition, the dogs did not show signs of interest, aggression, attention seeking, or over arousal behaviors.

In a single day of testing, the dog experienced all four conditions. The order of conditions was counterbalanced for each dog. The procedure was exactly the same before and during each condition, and there was approximately five minutes between each condition. The dog was played with prior to the start of the trials by the researcher when the owner was completing the necessary paperwork (approximately 10 minutes).

Testing Conditions

Neutral with stranger condition. This condition was one of the control conditions. In the three minutes that the dog experienced the condition, the researcher did as follows: The

researcher treated a plastic Halloween Jack-O-Lantern as if it were a real dog. The researcher was close enough to the dog to reach and touch the dog (approximately 2 feet), but far enough away that in case of an emergency the researcher could remove themselves from the situation (unlikely, the researcher underwent training from the shelter as well as prior training in several veterinary offices helping her to be more aware of the warning signs). The researcher wore a laboratory coat for this condition that was also used in the plain plush dog condition.

Neutral with owner condition. This condition was one of the control conditions for the dogs with owners. This condition was exactly the same as the neutral with researcher condition, except that the owner was the one with the plastic Jack-O-Lantern. This condition was only conducted in the subjects group of dogs with owners.

Jealousy with stranger condition. This was an experimental condition. This was to see if the dog would react in a jealous manner towards another dog receiving attention. The researcher started interacting with a stuffed dog in a playful manner, as if it were a real dog. The researcher said things to the plush dog such as “good boy” or “good girl”. The placement in the room was the same as the neutral condition, except that the plush dog was within reach of the dog being tested.

Jealousy with owner condition. This was an experimental condition. This was exactly the same as the jealousy condition, except the person inducing the jealousy was the owner. This condition would have only been conducted in the subjects group of dogs with owners.

Analysis

Two raters coded the videos taken during the trials. One rater was aware of the study’s purpose, whereas the other rater (blind to the study’s purpose) was used as a check for interrater reliability. The researcher trained the rater on what behaviors to look for (aggression, attention

seeking, over arousal, and interest and how they are manifested), and how to record the occurrence of the behaviors on the rating sheet (Appendix F).

The videos were downloaded onto a computer and coded. The behaviors were coded by appearance of the behavior and the frequency of the behavior, and with each appearance the raters made a tally. One rater rated all of the dogs, the second rater rated 20% of the interactions. A Pearson R correlation was used to assess interrrater reliability on the frequency of behaviors. Interrater reliability for interest was r=.61261, p<.001; for aggression was r=1.0, p<.001;for attention seeking behavior was r=.96, p<.001; and for over arousal it was r=1.0, p<.001. Aggression, attention seeking behavior, and over arousal were at a high and acceptable rate, but interest was lower than expected and therefore results regarding interest should be read with some caution. A Pearson R correlation was also used to examine the interrater reliability of presence or absence of a behavior. For interest, it could not be calculated because both variables were a constant (all of the dogs scored as having shown interest by both the researcher and rater). For aggression, the Pearson R statistic was r=1.0, p<.001. For attention seeking behavior, the Pearson R statistic was r=.78, p<.001. For over arousal behaviors, the Pearson R statistic was r=1.0, p<.001.

Codes

Through the replication of research by Harris and Prouvost (2014), it is most prudent to use the behaviors that they established as jealousy indicators. Although the type of jealousy that these behaviors exhibit is debatable, the presence of these behaviors does indicate that the canine is interested, uncomfortable, or upset by the situation.

Aggression. Aggression was characterized by any attempt the dog shows to bite or nip at the stimulus, especially when associated with lip curling or teeth bearing. In particular, when this

behavior was being coded for, the researcher or coder looked for signs of teeth bearing, lip curling, biting on any part of the stimulus, and growling and/or snarling. This was a behavior that was seen in Harris and Prouvost's (2014) research, and it is indicative of jealousy. Aggression is indicative of a jealousy-like just as an aggressive response in the monkeys during the fairness trials (some of them throwing the reward back at the researcher) is a display of frustration over unequal treatment (Bräuer & Hanus, 2012). Displays of this behavior show that the dog is being protective and proactive in defending what they feel is theirs (the attention being given out by the human).

Attention seeking. Attention seeking behavior was any act of the dog to gain the researcher's attention. This included pushing the researcher, pushing the stimulus, attempting to place themselves between the interaction with the researcher and the stimulus, or making vocalizations during the trial. When this behavior was being coded for by the researcher and coder, they looked for when the dog would push the stimulus or human with their hindquarters, when the dog would place it's body on or between the human and the stimulus, vocalizations during the trials that were not snarling (barking or whining), nudging with the nose towards the human, and licking the human. This was a behavior that was observed in Harris and Prouvost's (2014) research. It is an attempt by the dog to divert the human's attention away from the stimulus and back onto themselves. This is a non-violent behavior that the dog can use to coax the human to give them attention, which they feel they deserve, as opposed to another dog.

Interest/attention. In the terms of this experiment, interest was the amount of time the dog looked with head turned and gaze directed at the researcher, looked with head turned and gaze directed at the stimulus, and orientated head and body towards the stimulus. When this behavior was being coded for by the researcher or coder, they looked for the direction of gaze at

either the stimulus or human, sniffing of the stimulus, orientation of the head or body towards the stimulus or human. For example, when a dog gazed at the stimulus and looked away, this was counted as one display of interest. This was another behavior that was found in Harris and Prouvost's (2014) study. Although interest alone is not enough to infer a jealous-like reaction from (as interest could be related to an attention grabbing stimulus), coupled with aggression or attention seeking behavior it implies curiosity in the current situation.

Over arousal. This behavior was characterized as any attempt by the dog to be in charge or play with the stimulus, such as placing front paws on the stimulus and standing rigidly or performing simulated intercourse ("humping"). When this behavior was being coded for by the researcher or coder, they looked for the dog to place its front paws on the stimulus and stand rigidly with its head up, for the dog to hold onto the stimulus with its front paws while getting on top of the stimulus and humping it, or any attempt to do that. Over arousal is not a behavior that was coded for in Harris and Prouvost (2014) study. Research by Bauer and Smuts (2007) suggests that dominance and over arousal are common in play behaviors and competition. Their research investigated personality type of the dogs, and how their behavior in play differed. They found that older, larger, or typically "dominant" canines, when put into play pairs were not necessarily the dominant canine in play. These canines didn't hold themselves back from their full potential in play, but they also did not take charge of the situation. This demonstrates that over arousal is not a typical "dominant" behavior, but rather it is a reaction to another dog in a playful manner, regardless of if the other dog is playing. Over arousal by itself could mean different things (such as a dog being generally rude, immature, or obnoxious), but it is potentially indicative of a jealousy-like reaction in the dogs. It is suggestive of a jealousy-like reaction because the dogs are reacting to another dog receiving attention with an over aroused play state.

In other words, they see another dog receiving attention and the lack of fairness in the situation causes them to gain the other dog's attention, as opposed to the human.

General analysis approach. To assess the significance of the presence or absence of a behavior, a Chi-Square was run. The variables examined were the reactions to the pumpkin and plush dog. This was analyzed with all of the dogs as a whole, and with only the owned dogs with their owners in order to directly replicate Harris and Prouvost (2014). The Chi-Square was conducted on each of the DVs (interest, aggression, attention seeking, and over arousal). To assess the frequency of display of a behavior, a Repeated Measures ANOVA was run. The independent variables were subject group the dog is from (owner or shelter), the type of condition the dog is exposed to (pumpkin or plush dog), the sex and alteration status of the dog (male or female, altered or unaltered), and the breed grouping (large or small). As an exploratory variable, age was also analyzed using a Repeated Measures ANOVA. This was analyzed as a categorical variable for several reasons. The main reason is that in veterinary medicine, dogs from the age of one to six are seen as adults, and dogs above the age of seven are treated as seniors. This is because from about the age of seven onward, old age diseases start becoming more apparent in the dogs. In addition, at the age of seven is when veterinarians will start doing senior blood panels that are more extensive and comprehensive due to the frequency in which old age diseases start at that age. Dog food manufacturers also divide their dog foods into adult food for ages one to six, and senior foods for ages seven and above. The second reason is the age data was not normally distributed, and therefore it was a more logical analysis for age to be categorical. The dependent variable was the frequency of the behavior displayed.

Measures

Due to the cognitive nature of the conditions, HRV was analyzed as opposed to just heart rate. The physiological responses were measured using the Polar H7 heart monitor, as seen in Figure 2. Research by Essner, Sjöström, Ahlgren, and Lindmark, (2013), as well as Jonckheer-Sheehy, Vinke, and Ortolani, (2012) have validated the use of Polar H7 heart monitors. During the trials, the Polar H7 monitor was connected via Bluetooth to an iPhone 5s. The data was collected on this phone in an app called Elite HRV. The recordings in the dogs were taken over the three minute trial where the Polar H7 continuously recorded RR intervals, which was then used with the Kubios 2.2 software to derive the HRV (Berntson et al., 1997). The data was analyzed using the Frequency Domain Method, which is ideal for short term recordings between two and five minutes (Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology, 1996). This method counts the number of normal-to-normal (NN) intervals that match each band of assigned frequency (HF, LF, very low frequency) and determines the power in each band. If the bands fall between .15 and .4, they will be considered a HF band, if it falls between .04 and .15, they will be considered a LF band, and anything under .04 is a very low frequency band. This study was interested in the presence of HF-HRV. For the purposes of this study, any recordings that were not two minutes in length were excluded from analysis (13 cases across 124 trials). When the data was uploaded into the software, a very low artifact correction was used. This enabled any potential misses in heart beats by the Polar H7 to be accounted for, instead of showing a lag in time between beats. From there, the data that Kubios 2.2 had derived was put into SPSS to be analyzed. The data was then examined using a histogram and was found to be skewed. In order to normalize the data, it was transformed in SPSS using a natural logarithmic transformation. After being normalized, it was analyzed through the use of a Repeated Measures ANOVA.

Each of the shelter dogs in the study had a corresponding Canine Behavior Sheet, as seen in Appendix A. They each have scores on their arousal with toys, reaction to strangers, how they react to other dogs/on leash greetings with other dogs, and their length of stay. These scores were the predictor variables, and were compared with their responses during the trials to identify any correlation. The criterion variable was their reactions during the trials. In order to do this, a Multiple Regression was used to see if there is one variable that uniquely accounts for a percentage of the data. These were analyzed on an exploratory basis.

Also on an exploratory basis, each of the owned dogs in the study had a corresponding Owned Behavioral assessment Form, as seen in Appendix B. They each had scores on their arousal with toys, reaction to strangers, and how long the owner has owned them. These scores were the predictor variables, and were compared with their responses during the trials to identify any correlation. The criterion variable was their reactions during the trials. In order to do this, a Multiple Regression was used to see if there is one variable that uniquely accounted for a percentage of the data.

Results

Order effects were tested, looking for differences in responses of the dogs depending upon which order the trials were conducted in (whether it was the pumpkin or plush dog condition first, as they were randomized for each dog). The results were analyzed looking at the order that the dogs experienced the conditions, whether for the owned dogs it was the researcher or the owner with either stimuli, or for the shelter dogs either the pumpkin or plush dog. The results were analyzed looking at the dogs with the owner and researcher separately (due to the owned dogs experiencing each condition twice). There were no significant differences in any of the DVs for when the owned dogs experienced the owner with either the pumpkin ($F<1$) or plush

dog (F<1) in any order (first, second, third, or fourth). In addition, there were no differences in reactions of dogs when they experienced the researcher with the pumpkin (F<1) or the plush (F<1) in any of the possible order combinations. Therefore, given the lack of significant findings that can be accounted for by the presentation of human or stimuli, order was removed as a variable in the analysis, (most significant finding reported, (F(9, 85)=.963, p=.476; partial η^2=.076)).

Research Question 1. For the first research question, the study investigated if there was a difference between how dogs with owners (when in the researcher testing condition) react to the pumpkin or plush dog stimulus versus dogs in a shelter (Table 2). To answer this question, a Repeated Measures ANOVA was conducted for each of the DVs individually of interest, aggression, attention seeking, and over arousal between the pumpkin and plush dog condition examining owned dogs and shelter dogs, (2 [pumpkin or plush] x 2 [owned or shelter]). The behaviors were scored on frequency of display; therefore the values shown represent the number of times the behavior was observed by the coder. These results are only examining conditions in which the researcher was with the dogs. When examining interest in owned (Jack-O-Lantern, M=9.67, SD=4.81; Plush dog, M=10.10, SD=5.16) or shelter dogs (Jack-O-Lantern, M=13.80, SD=3.75; Plush dog, M=15.45, SD=6.25), there was not a significant difference in reactions, F<1. When examining aggression in owned (Jack-O-Lantern, M=.00, SD=.00; Plush dog, M=.43, SD=1.96) or shelter dogs (Jack-O-Lantern, M=.60, SD=2.68; Plush dog, M=1.90, SD=3.85), there was not a significant difference in reactions, F<1. When examining attention seeking behavior in owned (Jack-O-Lantern, M=2.14, SD=2.35; Plush dog, M=1.43, SD=1.99) or shelter dogs (Jack-O-Lantern, M=6.10, SD=5.71; Plush dog, M=4.65, SD=6.19), there was not a significant difference in reactions, F<1. There was an interaction with dog group and

condition in that dogs showed a significant difference in the frequency of over arousal behaviors between the owned dogs (Jack-O-Lantern, M=.00, SD=.00; Plush dog, M=.43, SD=1.96) and shelter dogs (Jack-O-Lantern, M=.10, SD=.45; Plush dog, M=3.7, SD=5.74) when the researcher was with the pumpkin or plush dog, such that the shelter dogs displayed the most over arousal behaviors, (F(1, 39)=5.99, p<.05; partial η^2=.133) (Table 2).

In order to examine the physiological measures regarding research question one, a Repeated Measures ANOVA was conducted. This examined for differences regarding HF-HRV individually in either the pumpkin or plush dog condition between the owned and shelter dogs (2 [pumpkin or plush] x 2 [owned or shelter]) when they were with the researcher (Table 3). When When the HF-HRV was examined between conditions, there was no significant interaction between owned (Jack-O-Lantern, M=7.38 ms², SD=1.16; Plush dog, M=7.92 ms², SD=1.31) or shelter dogs (Jack-O-Lantern, M=6.64 ms², SD=1.12; Plush dog, M=6.94 ms², SD=1.08) and condition, F<1 (Table 3). There was a main effect of group in which shelter dogs (M=6.79 ms²) had a decreased HF-HRV as compared to owned dogs (M=7.72 ms²), (F(1, 33)=6.63, p<.05; partial η^2=.167) (Figure 4 and Figure 5). There was also a main effect of condition in which the pumpkin condition (7.06 ms²) had a decreased HF-HRV as compared to the plush dog condition (7.45 ms²), (F(1, 33)=4.578, p<.05; partial η^2=.122).

Prelude to RQ2-4 and the exploratory section. The following research questions are all dealing with the same 32 analysis in order to examine four different dependent variables. All of the dependent variables were analyzed in a 2 x 2 fashion, with 2 (target: pumpkin or plush) x 2 [breed (large or small), sex (male or female), alteration status (neutered or non-neutered), age (adult or senior)]. Research question 2 is only examining the main effects of those 32 analysis, and in order to not be redundant, the main effects will not be reported in other research

questions. The other research questions will be examining breed differences, sex and alteration status, and age. The reported findings for those research questions (Research questions 3 and 4, and Exploratory analysis) are reported as interactions.

Research Question 2. For the second research question, it explored whether dogs (owned dogs with researcher or owner, analyzed separately) would react differently to a neutral stimulus (Jack-O-Lantern) as compared to a jealousy provoking stimulus (fake plush dog). The behaviors were scored on the frequency in which the behavior was displayed; therefore all values represent the number of times the behavior was observed by the coder. To answer this question, a Repeated Measures ANOVA was conducted for interest, aggression, attention seeking, and over arousal, independently. These reactions were analyzed with owned dogs with their owners between the pumpkin and plush dog (Table 2). When analyzing for an interaction with condition and breed (2 [pumpkin or plush] x 2 [breed, large or small]), there was a main effect of condition in which dogs displayed more interest towards the plush dog (M=11.24, SD=5.14) than the pumpkin (M=9.29, SD=4.76), (F(1, 19)=6.33, p<.05; partial η^2=.250). When analyzing for an interaction with condition and sex (2 [pumpkin or plush] x 2 [sex, male or female]), there was a main effect of condition in which dogs displayed more interest towards the plush dog than the pumpkin, (F(1, 19)=5.41, p<.05; partial η^2=.222). When analyzing for an interaction with condition and age (2 [pumpkin or plush] x 2 [age, adult or senior]), there was a main effect of condition in which dogs displayed more interest towards the plush dog than the pumpkin, (F(1, 19)=6.83, p<.05; partial η^2=.264). For aggression, none of the owned dogs displayed any aggression during the trials and therefore, the results were non-significant (Jack-O-Lantern, M=.00, SD=.00; Plush dog, M=.00, SD=.00), F<1. When examining attention seeking behavior, there were no main effects of condition (Jack-O-Lantern, M=1.81, SD=1.66; Plush dog, M=3.95,

SD=7.25), (*F*(1, 19)=2.56, *p*=.126; partial η^2=.119). When examining over arousal in the owned dogs, there were no main effects of condition (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.10, *SD*=.44), *F*<1.

In order to examine the effects of the researcher with the owned dogs on their reactions to the pumpkin or plush dog conditions, a Repeated Measures ANOVA was conducted individually for interest, aggression, attention seeking, and over arousal (2 [pumpkin or plush] x 2 [breed, large or small; sex, male or female; age, adult or senior]) (Table 2). In examining for main effects of condition for interest, the results were non-significant (Jack-O-Lantern, *M*=9.67, *SD*=4.81; Plush dog, *M*=10.10, *SD*=5.16), *F*<1. For aggression, there were no main effects of condition (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.43, *SD*=1.96), (*F*(1, 20)=1.00, *p*=.329; partial η^2=.048). For attention seeking, there were no main effects of condition (Jack-O-Lantern, *M*=2.14, *SD*=2.35; Plush dog, *M*=1.43, *SD*=1.99), (*F*(1, 20)=1.29, *p*=.27; partial η^2=.061). For over arousal behaviors, there were no main effects of condition (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.43, *SD*=1.96), (*F*(1, 20)=1.00, *p*<.329; partial η^2=.048).

In order to examine the effects of the relationship that the dogs had with the person in the room on the owned dogs (whether it be the researcher or the owner) to their reactions to the pumpkin conditions, a Repeated Measures ANOVA was conducted individually for interest, aggression, attention seeking, and over arousal (2 [owner or researcher] x 2 [breed, large or small; sex, male or female; age, adult or senior]). In examining for main effects of person in the room for interest, the results were non-significant (Owner, *M*=9.29, *SD*=4.76; Researcher, *M*=9.67, *SD*=4.81), *F*<1. For aggression, there were no results because none of the dogs displayed aggression during the pumpkin conditions, *F*<1. For attention seeking, there were no main effects of human (Owner, *M*=1.81, *SD*=1.66; Researcher, *M*=2.14, *SD*=2.35), *F*<1. For

over arousal behaviors, there were no results because none of the dogs displayed over arousal during the pumpkin conditions, $F<1$.

In order to examine the effects of the relationship that the dogs had with the person in the room on the owned dogs (whether it be the researcher or the owner) to their reactions to the plush dog conditions, a Repeated Measures ANOVA was conducted individually for interest, aggression, attention seeking, and over arousal (2 [owner or researcher] x 2 [breed, large or small; sex, male or female; age, adult or senior]). In examining for main effects of person in the room for interest, the results were non-significant (Owner, $M=11.24$, $SD=5.14$; Researcher, $M=10.10$, $SD=5.16$), $F<1$. For aggression, there were no main effects of human (Owner, $M=.00$, $SD=.00$; Researcher, $M=.43$, $SD=1.96$), ($F(1, 20)=1.00$, $p<.329$; partial $\eta^2=.048$). For attention seeking, there were no main effects of human (Owner, $M=3.95$, $SD=7.25$; Researcher, $M=1.43$, $SD=1.99$), ($F(1, 20)=2.34$, $p=.141$; partial $\eta^2=.105$). For over arousal behaviors, there were no main effects of human (Owner, $M=.10$, $SD=.44$; Researcher, $M=.43$, $SD=1.96$), ($F(1, 20)=1.00$, $p<.329$; partial $\eta^2=.048$).

In order to examine the effects of the pumpkin and plush dog on physiological measures, a Repeated Measures ANOVA was conducted for HF-HRV for owned dogs with the researcher or with their owners, (2 [pumpkin or plush] x 2 [owner or researcher]) (Table 3For HF-HRV, the results were non-significant between the owner (Jack-O-Lantern, $M=7.65$ ms², $SD=1.59$; Plush dog, $M=7.59$ ms², $SD=1.24$) and the researcher (Jack-O-Lantern, $M=7.38$ ms², $SD=1.16$; Plush dog, $M=7.92$ ms², $SD=1.31$), ($F(1, 14)=2.89$, $p=.111$; partial $\eta^2=.171$).

Research Question 3. In regards to research question number three which proposed a difference in reactions based on small and large breeds, a Repeated Measures ANOVA was conducted individually on interest, aggression, attention seeking, over arousal, and HF-HRV, (2

[pumpkin or plush] x 2 [large or small]) (Table 4). The results were non-significant both behaviorally and physiologically in their reactions: Interest [Small (Jack-O-Lantern, *M*=14.15, *SD*=3.76; Plush dog, *M*=14.95, *SD*=5.89), Large (Jack-O-Lantern, *M*=9.33, *SD*=4.47; Plush dog, *M*=10.57, *SD*=5.97)], *F*<1; Aggression [Small (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=1.15, *SD*=3.12), Large (Jack-O-Lantern, *M*=.57, *SD*=2.62; Plush dog, *M*=1.14, *SD*=3.14)], *F*<1; Attention Seeking [Small (Jack-O-Lantern, *M*=3.20, *SD*=4.31; Plush dog, *M*=2.30, *SD*=3.33), Large (Jack-O-Lantern, *M*=4.90, *SD*=5.04; Plush dog, *M*=3.67, *SD*=5.85)], *F*<1; Over arousal [Small (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=1.60, *SD*=3.60), Large (Jack-O-Lantern, *M*=.10, *SD*=.44; Plush dog, *M*=2.43, *SD*=5.29)], *F*<1; HF-HRV [Small (Jack-O-Lantern, *M*=7.26 ms², *SD*=1.41; Plush dog, *M*=7.82 ms², *SD*=1.26), Large (Jack-O-Lantern, *M*=6.97 ms², *SD*=.98; Plush dog, *M*=7.21 ms², *SD*=1.32)], *F*<1.

Research Question 4. Research question number four was investigating whether there were differences in reactions based on the sex of the animal. To answer this question, a Repeated Measures ANOVA was conducted individually on interest, aggression, attention seeking, and over arousal between the pumpkin and plush dog conditions dependent on the sex of the dog, (2 [pumpkin or plush] x 2 [male or female]) (Table 5). This interaction is first analyzed in dogs that only experienced the researcher. For interest, the results were non-significant [Male (Jack-O-Lantern, *M*=12.00, *SD*=5.44; Plush dog, *M*=12.12, *SD*=6.59), Female (Jack-O-Lantern, *M*=11.19, *SD*=3.54; Plush dog, *M*=13.63, *SD*=5.78)], *F*(1, 39)=1.746, *p*=.194; partial η^2=.043). For aggression, the results were significant between reactions of male dogs (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=1.84, *SD*=3.82) and female dogs (Jack-O-Lantern, *M*=.75, *SD*=3.00; Plush dog, *M*=.06, *SD*=.25), such that male dogs reacted with increased aggression in the plush dog condition as compared to female dogs, *F*(1, 39)=5.25, *p*<.05; partial η^2=.119). For

attention seeking, the results were non-significant [Male (Jack-O-Lantern, *M*=4.12, *SD*=5.19; Plush dog, *M*=2.88, *SD*=3.98), Female (Jack-O-Lantern, *M*=4.00, *SD*=4.03; Plush dog, *M*=3.19, *SD*=5.96)], $F<1$. For over arousal, the results were non-significant [Male (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=2.68, *SD*=5.09), Female (Jack-O-Lantern, *M*=.13, *SD*=.50; Plush dog, *M*=1.00, *SD*=3.29)], $F(1, 39)=1.672$, $p=.204$; partial $\eta^2=.041$).

This question also investigated owned dogs with their owners. To investigate this, a Repeated Measures ANOVA was conducted individually on interest, aggression, attention seeking, and over arousal between the pumpkin and plush dog conditions dependent on the sex of the dog, (2 [pumpkin or plush] x 2 [male or female]) (Table 6). For interest, the results were non-significant [Male (Jack-O-Lantern, *M*=8.67, *SD*=3.94; Plush dog, *M*=11.67, *SD*=5.16), Female (Jack-O-Lantern, *M*=10.11, *SD*=5.82; Plush dog, *M*=10.67, *SD*=5.36)], $F(1, 19)=2.558$, $p=.126$; partial $\eta^2=.119$). For aggression, an analysis could not be conducted because there were no displays of aggression in the owned dogs, $F<1$. For attention seeking, the results were non-significant [Male (Jack-O-Lantern, *M*=1.58, *SD*=1.93; Plush dog, *M*=1.83, *SD*=1.64), Female (Jack-O-Lantern, *M*=2.11, *SD*=1.27; Plush dog, *M*=6.78, *SD*=10.58)], $F(1, 19)=2.062$, $p=.167$; partial $\eta^2=.098$). For over arousal, the results were non-significant [Male (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.17, *SD*=.58), Female (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.00, *SD*=.00)], $F<1$.

When investigating if the alteration status of the animal made a difference on the reactions, a Repeated Measures ANOVA was conducted individually on interest, aggression, attention seeking, and over arousal between the pumpkin and plush dog conditions with the researcher, (2 [pumpkin or plush] x 2 [altered or unaltered]). For interest, the results were non-significant [Altered (Jack-O-Lantern, *M*=11.10, *SD*=4.93; Plush dog, *M*=11.90, *SD*=6.08),

Unaltered (Jack-O-Lantern, *M*=13.27, *SD*=4.03; Plush dog, *M*=14.91, *SD*=6.50)], *F*<1. For aggression, the results were non-significant [Altered (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.93, *SD*=2.86), Unaltered (Jack-O-Lantern, *M*=1.09, *SD*=3.62; Plush dog, *M*=1.73, *SD*=3.72)], *F*<1. For attention seeking, the results were non-significant [Altered (Jack-O-Lantern, *M*=3.57, *SD*=4.58; Plush dog, *M*=3.00, *SD*=5.39), Unaltered (Jack-O-Lantern, *M*=5.45, *SD*=5.03; Plush dog, *M*=3.00, *SD*=2.65)], *F*(1, 39)=1.675, *p*=.203; partial η^2=.041). For over arousal, the results were non-significant [Altered (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=1.40, *SD*=3.67), Unaltered (Jack-O-Lantern, *M*=.18, *SD*=.60; Plush dog, *M*=3.73, *SD*=6.15)], *F*<1.

For owned dogs, an analysis on alteration status could not be conducted because all of the owned dogs had already been altered. Lastly, there were no significant differences in reactions related to castration status and sex, *F*<1.

Exploratory analysis. In addition to the analysis on owned or shelter dogs, breed and sex, age was also examined. A Repeated Measures ANOVA was conducted individually investigating the differences in interest, aggression, attention seeking, and over arousal based on age, (2 [pumpkin or plush] x 2 [adult or senior]) (Table 8). Age was used as a categorical variable based on the standards in veterinary medicine where any dog above the age of seven years is considered a senior. Therefore, dogs between the ages of one to six years were adults and any dog seven years or above was a senior. In addition, the ages of the dogs were not normally distributed, so examining age as a categorical variable was more sensible. When the dogs were examined for levels of interest with the researcher, the results were non-significant [Adult (Jack-O-Lantern, *M*=12.09, *SD*=3.99; Plush dog, *M*=13.23, *SD*=5.36), Senior (Jack-O-Lantern, *M*=11.21, *SD*=5.58; Plush dog, *M*=12.11, *SD*=7.27)], *F*<1. For aggression, the results were

non-significant [Adult (Jack-O-Lantern, *M*=.55, *SD*=2.56; Plush dog, *M*=2.05, *SD*=4.02), Senior (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.11, *SD*=.46)], $F(1, 39)=1.531$, $p=.223$; partial $\eta^2=.038$). For attention seeking, the results were non-significant [Adult (Jack-O-Lantern, *M*=4.00, *SD*=4.27; Plush dog, *M*=2.05, *SD*=2.48), Senior (Jack-O-Lantern, *M*=4.16, *SD*=5.32; Plush dog, *M*=4.11, *SD*=6.42)], $F(1, 39)=2.18$, $p=.148$; partial $\eta^2=.053$). For over arousal, the results were significant between adult dogs (Jack-O-Lantern, *M*=.09, *SD*=.43; Plush dog, *M*=3.68, *SD*=5.69) and senior dogs (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.11, *SD*=.46), such that adult dogs displayed more over arousal behaviors, ($F(1, 39)=7.44$, $p<.05$; partial $\eta^2=.160$).

In order to examine just the owned dogs with their owners, A Repeated Measures ANOVA was conducted individually on interest, aggression, attention seeking, and over arousal based on age, (2 [pumpkin or plush] x 2 [adult or senior]) (Table 9). For interest, the results were non-significant [Adult (Jack-O-Lantern, *M*=11.67, *SD*=3.53; Plush dog, *M*=12.92, *SD*=4.48), Senior (Jack-O-Lantern, *M*=6.11, *SD*=4.43; Plush dog, *M*=9.00, *SD*=5.34)], $F(1, 19)=1.071$, $p=.314$; partial $\eta^2=.053$). For aggression, none of the owned dogs displayed aggressive behaviors and therefore the results were non-significant, $F<1$. For attention seeking, the results were non-significant [Adult (Jack-O-Lantern, *M*=2.00, *SD*=1.54; Plush dog, *M*=5.33, *SD*=9.43), Senior (Jack-O-Lantern, *M*=1.56, *SD*=1.88; Plush dog, *M*=2.11, *SD*=1.54)], $F<1$. For over arousal, the results were non-significant [Adult (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.17, *SD*=.58), Senior (Jack-O-Lantern, *M*=.00, *SD*=.00; Plush dog, *M*=.00, *SD*=.00)], $F<1$.

A Repeated Measures ANOVA was conducted looking at shelter dogs' reactions based on how long they had been in the shelter, (2 [pumpkin or plush] x 7 [lengths of time in the shelter]). For interest, there were no significant interactions with their reactions to the pumpkin

or plush and their time in the shelter, $F(6, 13)=1.082$, $p=.422$; partial $\eta^2=.333$) (Table 10). For aggression, the results were non-significant, $F(6, 13)=1.192$, $p=.369$; partial $\eta^2=.355$). For attention seeking behavior, there was a significant between the pumpkin and plush conditions dependent on their time in the shelter, such that dogs that were at the shelter longer performed more attention seeking behavior, $F(6, 13)=3.821$, $p<.05$; partial $\eta^2=.638$). For over arousal, there were no significant results, $F<1$.

The levels of arousal scores that the shelter dogs were rated on at intake in the shelter were compared to their over arousal ratings during the experiment using a Pearson R correlation. For their levels of arousal scores and their over arousal to the pumpkin, the results were non-significant, $r=.357$, $p=.122$. For their levels of arousal scores and their over arousal to the plush dog condition, the results were non-significant, $r=-.208$, $p=.379$.

A Repeated Measures ANOVA was conducted to look for any interactions with owned or shelter dogs, (2 [level of arousal or reactions to strangers] x 2 [owned or shelter]). There was a significant interaction in their level of arousal (Owned, $M=4.52$, $SD=3.56$; Shelter, $M=2.10$, $SD=1.25$), their reaction to strangers (Owned, $M=2.19$, $SD=1.89$; Shelter, $M=1.75$, $SD=.91$), and whether they were an owned dog or a shelter dog such that owned dogs were rated as being more aroused and playful and also in reacting more negatively to strangers, ($F(1, 39)=5.43$, $p<.05$; partial $\eta^2=.122$) (reactions to strangers was reverse coded, higher numbers meant more negative reactions).

An Independent Samples T-Test was conducted to compare the level of arousal scores between owned and shelter dogs. Owned dogs ($M=4.52$, $SD=3.56$) were rated higher on arousal scores than shelter dogs ($M=2.10$, $SD=1.25$), $t(39)=2.88$, $p=.006$. An Independent Samples T-Test was conducted to compare the reaction to strangers scores between owned and shelter dogs.

No significant differences in reactions to strangers were found between owned (M=2.19, SD=1.89) or shelter dogs (M=1.75, SD=0.91), $t(39)$=.944, p=.351.

In order to investigate if there were differences in the presence or absence of behaviors in all of the dogs, a Chi Square was conducted. This analysis does not take into effect the relationship between the dogs and the person performing the experiment. The results show that for all dogs there was a significant difference between the levels of interest they showed towards the pumpkin and the plush dog, such that they displayed significantly more interest towards the plush dog, X^2 (1, N=41)=19.99, p<.001. In addition, there was also a significant difference in the presence or absence of aggression between the Jack-O-Lantern condition and plush dog, such that aggression was present significantly more in the plush dog condition, X^2 (1, N=41)=4.98, p<.05. There were no significant differences found in the presence or absence of attention seeking behaviors (X^2 (1, N=41)=1.82, p=.18) or over arousal (X^2 (1, N=41)=3.64, p=.056) between the two conditions.

Harris and Prouvost analysis replication. In order to conceptually imitate the Harris and Prouvost (2014) study, a Chi Square was conducted on just the owned dogs with the owner (Table 11). This was done in order to examine if there is a difference in the presence or absence of behaviors depending upon the relationship that the dogs have with their owners. There was a significant difference in the presence or absence of interest. Dog's showed significantly more interest in the plush dog (20/21) than in the pumpkin (19/21), X^2 (1, N=21)=9.98, p<.05. There was a marginal significance in attention seeking behavior, where the dog's showed more attention seeking behavior towards the plush (13/21) than towards the pumpkin (8/21), X^2 (1, N=21)=2.91, p=.088. As for aggression (Jack-O-Lantern: presence 0/21, absence 21/21; Plush: presence 0/21, absence 21/21) and over arousal (Jack-O-Lantern: presence 0/21, absence 21/21;

Plush: presence 1/21, absence 20/21), there was not a significant finding in the presence or absence of the behaviors, $p > .05$.

In total, 56 separate Repeated Measure ANOVAs were conducted on the behavioral data alone, with 10 significant findings and two marginally significant findings. For the physiological data, four separate Repeated Measure ANOVAs were conducted in order to fully analyze the data, with two significant findings and two marginally significant findings. The implication of running many statistical tests is the increase in error that occurs. Given the relatively low number of subjects in each group, teasing apart the results for significance with an omnibus test did not seem as effective. Running this many separate ANOVAs was deemed to be the best option as it would more likely find a significant effect, although it does potentially increase the Type I error rate. A Type 1 error is problematic because of the potential for a false positive, especially with running so many statistical tests. In this study in particular, having so many analysis conducted using the Repeated Measures ANOVA can increase the error rate from a .05, and therefore tests that come out significant may not be significant. In regards to how much trust should be put into these results, although the Type I error rate is increased, the results that were found and reported were significant at the .05 level or below. The results that were marginally significant were at the .09 level or below. With more participants in the research, these results should turn out to be stronger findings.

Discussion

Research Question 1. The first research question was investigating if there is a difference between how shelter dogs and owned dogs react to the two conditions. Overall, the results showed that shelter dogs displayed significantly more over arousal behaviors than owned dogs. Specifically, when the researcher was the person interacting in the conditions, over arousal

behaviors were more frequent in shelter dogs than in owned dogs during the plush dog condition. It was predicted that shelter dogs would react with increased frequency of behaviors as compared to the owned dogs. Over arousal was the main area of difference between owned and shelter dogs. Otherwise, owned dogs and shelter dogs displayed the same amount of aggression, attention seeking, and interest. All values can be seen in Table 2.

Over arousal is a behavior that is displayed when a dog is unable to control their behaviors and reactions, and therefore they over react. In other words, the dog is being excessively playful and rude. In addition, over arousal was a behavior that did not neatly fit into aggression or attention seeking, and therefore it needed to be coded for separately. This is not a behavior that Harris and Prouvost (2014) examined, and consequently, over arousal was a behavior of particular notice, in that there was a significant difference in the frequency of behavior between the Jack-O-Lantern conditions and the plush dog conditions between the owned and shelter dogs groups. Over arousal is a play behavior that can be found in all dogs (owned and shelter dogs) but given the differences in circumstances between owned and shelter dogs, it makes sense that shelter dogs tend to display more over arousal than owned dogs. In fact, this is directly in line with what is expected. Shelters are stressful environments for the dogs to be in, and therefore reactions such as over arousal due to stress are expected (Thorn et al., 2006). However, this behavior can be seen in owned and shelter dogs, but often times behavioral issues are the reasons a dog ends up in a shelter (Barrera, at al., 2010). Therefore, over arousal in shelter dogs being above and beyond the owned dogs is not an unusual finding, but it is important to note. In addition, research has shown that generally dogs play behavior is displayed in pairs, rarely in anything larger (Adler, Mackensen-Friedrichs, Franz, & Crailsheim, 2011). Therefore, the current study in the plush dog condition meets this criterion exactly.

Over arousal can be seen as a way for a dog to gain the attention of another dog, therefore indicative of a jealousy-like reaction. The dog perceives the lack of fairness in the situation (with the human only giving attention to one dog) and in order to receive attention for themselves, they turn to the other dog present. This is all presumably an unconscious reaction to another dog receiving attention. In addition, over arousal tends to be above and beyond the typical play behavior that dogs display, therefore over arousal cannot just be accounted for by the dog acting playful.

When examining the exploratory analysis results of the shelter dogs and their time in the shelter, over arousal reactions remain consistent regardless of how long they are in the shelter for. Yet, attention seeking behavior increases the longer they are in the shelter. Although there are no significant differences in attention seeking behavior between owned and shelter dogs, it should be noted that the less attention the dogs receive over time, the more attention seeking behavior they perform.

Although there was not a significant difference in owned dogs and shelter dogs between conditions, there was an overall main effect of HF-HRV. This decrease in HF-HRV for the shelter dogs overall could indicate that they were overall more stressed during the trials than the owned dogs. Potentially, it was a more stressful situation for the shelter dogs to watch the researcher give attention to a pumpkin and a plush dog than it was for the owned dogs. This could be due to the lack of attention that the dogs receive on a daily basis, and watching another object in front of them get attention that they are lacking could be stressful. It could also indicate that the shelter dogs experienced an increase in mental workload during the trials, where they were trying to understand the situation. Watching the researcher give attention to two seemingly inanimate objects could be perplexing and that could have caused the change in HF-HRV in the

shelter dogs. There is clearly a physiological change in the canines when they are put into a more stressful situation, such as in the shelter.

In short, regarding the first research question of if there are differences between owner dogs and shelter dogs, the results suggest that there are some differences in reactions. Owned dogs and shelter dogs reacted differently in their levels of over arousal and marginally on their levels of attention seeking behavior, although their levels of interest and aggression were the same among the groups. The increase in frequency of over arousal in shelter dogs is not that surprising: over arousal is a playful and rude behavior that all dogs can display, but dogs in stressful situations such as a shelter may be more prone to displaying this behavior in a rude manner. Given the main effect of shelter dogs having a decreased HF-HRV, it would be safe to assume that the difference in reactions seen between the groups is due to environmental differences as opposed to a jealousy-like reaction.

Research Question 2. The second research question investigated whether dogs would react differently to the neutral stimulus as compared to the jealousy provoking stimulus. It was predicted that there would be a significant difference in reactions, in particular that there would be an increase in interest, aggression, attention seeking, and over arousal behaviors in response to the plush dog. Overall, the hypothesis was partially supported by these results (Table 3).

First, when the owned dogs were with the owner, the results showed that there was a significant increase in the frequency of interest during the plush dog condition. Secondly, when examining the results of the researcher with the owned dogs on frequency of behavior, there were no significant or marginally significant differences in reactions. Thirdly, and perhaps most importantly, when directly comparing the owner and researcher with either the pumpkin or plush dog conditions, there were no differences in reactions of the owned dogs.

Overall, similar behavioral reactions as Harris and Prouvost (2014) were found, where this research does agree with Harris and Prouvost (2014) that dogs will display interest more in the plush dog than in the Jack-O-Lantern condition. The owned dogs with the owner is a direct comparison of Harris and Prouvost's (2014) research, which had found there was a significant difference in behaviors of how dogs reacted to a neutral stimulus (Jack-O-Lantern) as compared to a plush dog. This research had found that there was a significant difference in the frequency of displays of interest during the plush dog conditions, but no other behaviors. Interest alone is much less telling than having it combined with attention seeking behavior, aggression, or over arousal. Essentially, this research and Harris and Prouvost's (2014) research found that dogs are much more attentive when a human is paying attention to another dog as compared to when they are paying attention to a Jack-O-Lantern toy. In the exploratory analysis, there was a marginal significant difference in how much attention seeking behavior the dogs displayed, but there was not a significant difference in the frequency of attention seeking behavior. If there were more dogs in the study, there is the potential for the attention seeking behavior to be significant in both the presence or absence analysis, and also in the frequency analysis. This would give a stronger case to a jealousy-like reaction from the dogs. By itself, interest is not a strong enough indicator of a jealousy reaction. Interest was simply rated as where the dog's gaze was directed, and how frequently they redirected their gaze towards the researcher or stimulus. Alternative explanations for a gaze redirection could be because of a noise that peaked their attention and drew their gaze towards the stimulus. Another reason could simply be that the dogs developed an actual interest in the researcher and stimulus.

In addition, given the lower-than-desirable rate of interrater reliability of interest, it is difficult to say whether the significant difference in interest is due to a true difference between

owned dogs with the pumpkin or plush dog or whether it is due to a data coding error. There is the possibility that the coder used to check for interrater reliability was not reliable in this measure, but that cannot be counted on. Therefore, the results of interest need to be examined knowing that they might not be a reliable measure.

Potentially, the increased interest that owned dogs displayed towards the plush dog as opposed to the Jack-O-Lantern could be an indication of intelligence level. This could again be related to the increased resources that owned dogs have. They were able to observe that their owner was with another dog, but it wasn't as large of a threat to them due to the plentiful resources that they already have. Research has been conducted showing the difference in social skills in shelter and owned dogs (Barrera et al., 2010; Duranton & Gaunet, 2016), perhaps the enriched environment in a home has also increased owned dogs intelligence. At this time, research on this topic could not be found. Although this finding is similar to what Harris and Prouvost (2014) found in their research, this behavior alone is not enough to say that the dogs were experiencing jealousy. Interest is simply where the dog was directing its attention. Therefore, the dog could be interested in the stimulus because of the potential jealousy component, or it could be due to the talking that was occurring during the trials.

When looking at the presence or absence of behaviors with the owned dogs with their owners (a direct replication of Harris and Prouvost, 2014), there is a significant difference in the presence or absence of interest, and a marginal significance in the presence or absence of attention seeking behavior. Interestingly, the marginal significance of attention seeking behavior in the owned dogs with their owners is not reflected in the frequency of behavior displays. However, potentially there would be an increase in the significance of the frequency of attention seeking behavior had there been more dogs in the research.

When the frequencies of behaviors in the owned dogs with the owner were examined, the only difference was in interest. When the frequencies of behaviors in owned dogs with the researcher were examined, there were no significant differences in behaviors, and when the researcher and owner were compared directly, there were no significant differences in behavioral reactions. One cannot forget the low interrater reliability rate of interest. Given the nature of this measure and the low rate of interrater reliability, potentially the parameters for measuring interest are not specific enough. With that in mind, the differences in interest between the owned dogs with their owners and in the other conditions could be due to the relationship with the owner. The history of reinforcement that the dogs have with the owner could have been enough to generate more interest in the stimuli when the owner was interacting with it. Although, these differences in interest were not enough to create a significant difference in interest between the researcher and owner conditions. Therefore, I would conclude that the relationship between the owner and dog is only marginally significant when it comes to an interest reaction, given that there is no significant difference in how the dogs reacted with the researcher, and there was no significant difference in how the dogs reacted between the researcher and owner conditions.

There are several differences in the conditions between the current study and Harris and Prouvost's (2014) research. With the owners, the owned dogs displayed a difference in interest. There were no differences in reactions when owned dogs were with the researcher. The results indicate that potentially the relationship between the owner and the dog matters in the reactions of the dog, but only when it comes to how interested the dog is in the stimulus. Otherwise, the relationship between the human and the dog is irrelevant because when the researcher and owner were compared, there were no differences in reactions between the dogs. This is interesting, because the history of reinforcement that the owner has with the dog, despite that each dog had

been owned at least a year or more, this history does not affect how they react. Therefore, this result indicates that the relationship is potentially not necessary for the behavioral reactions displayed.

The increase in frequency of interest when the owned dogs were with the owners could indicate that the relationship between the dog and owner is necessary for a reaction, but it doesn't appear that the relationship between the owner and the dog is essential for a jealousy-like reaction given the lack of significant differences between the reactions of the owned dogs with the owner or researcher.. There is the possibility that the situation of watching their owners pay attention to another dog is stressful and curious to them, but not enough for the dogs to act upon changing the situation.

Research Question 3. Research question number three predicted that there would be differences in reactions based on the size of the breed of the dog (in this study, there were N=20 small breeds, and N=21 large breeds with equal numbers in each the owned dogs and shelter dogs groups). It was predicted that smaller breeds would react more strongly than larger breeds in the various conditions. This hypothesis was not supported by the results. The results indicate that the size of the dog, and therefore its breed, do not influence the behaviors of the dog in this type of situation, regardless of if they were an owner dog or shelter dog. Research by Arhant et al. (2010) indicated that differences in how owners treat small vs. large breed dogs could account for differences in their behavior. Perhaps, the differences in treatment is not as pronounced as previously thought, and therefore the different sizes of breeds are treated relatively the same across owners. Another possibility could be the sample of dogs that were chosen. The dogs were obtained from a convenience sample, where the owners were all familiar with the researcher in either a personal or professional level. The shelter used was a single shelter in western New

York. There is a possibility that by using convenience sampling to obtain the owner and shelter dogs caused an abnormal similarity in treatment of the canines across breeds. Most of the owners that were pulled for the research lived in a rural area, and a large majority of them were from a local veterinary office. Perhaps those owners treated their large and small dogs more similar across breeds. In addition, the shelter was a large animal shelter in New York State, where differences in treatment depending on breed would not be tolerated due to the large amount of dogs present.

Research Question 4. Research question number four aimed to examine the sex differences in behaviors of dogs between trials. It was hypothesized that there would be sex differences based on the sex of the dog, but there would not be differences based off of their alteration status. The current study had 16 females and 25 males, with 30 dogs having been altered and 11 still intact. As predicted, the results show that there was a difference between the reactions of the dogs based on sex, and there was not a difference in reactions of dogs based off of castration status. It was expected that there would be an overall increase in reactions from male dogs, but instead only certain behaviors were attributed to a sex difference. In addition, my results support Pérez-Guisado and Muñoz-Serrano (2009) who said that the castration status of a dog would not affect their behavior.

The main differences between the sexes were in aggression, and even this main difference was only present in shelter dogs (owned dogs never displayed aggression during the trials). When the individual in the conditions was only the researcher, the males displayed significantly more aggression towards the plush dog than the females did. Finally, there was a marginal significance of alteration status on attention seeking behavior, such that altered dogs displayed more attention seeking behavior than unaltered dogs. The finding that male dogs

display more aggression than the female dogs was expected; male dogs tend to be more aggressive towards intruders (the plush dog) than females, and therefore more likely to get upset over what they feel is theirs (Pérez-Guisado & Muñoz-Serrano, 2009). The interesting finding here is that male dogs became aggressive towards the plush dog, whereas female dogs did not. This is not something that had been expected to find, but it does lend evidence to the differences in the sexes of the dogs on behavior. The male dogs attempted to incapacitate the intruder in the room to get to the human. The differing reactions that the male and female dogs have could be due to their upbringing being slightly different based on sex, or it could be due to their biological differences due to sex. Further research would have to be conducted in order to discern where the difference is at.

Exploratory Analysis. For the exploratory analysis, the reactions the dogs had were examined in terms of age, and the behavioral paperwork was examined to see if there was an underlying character difference between the dogs. The results found that there were differences in reactions depending upon age. When the researcher was with the dogs, there was an age difference in reactions to the plush dog condition with over arousal. Younger dogs displayed more over arousal than older dogs.

The age difference in the adult dogs as compared to the senior dogs in over arousal is not surprising. Although research has been conducted on differences in cognitive abilities in younger and older dogs (Adams et al., 2000a), there is not much research on behavioral differences between young and old dogs. In this study, the adult dogs reacted with more over arousal towards the plush dog than the senior dogs. This result is logical for several reasons. First off, displaying over arousal is a fairly energy demanding task. The dogs were often on their hind legs, and they were often humping the fake dog. As an older dog, potentially the energy strain

that displaying over arousal has could be a deterrent for them. Another reason for this difference could simply be that they are not as affected by watching another dog get attention. They may not react with over arousal as much because they simply do not care as much as a younger dog. This could be due to the dogs being older and more mature than the younger dogs, and therefore being less likely to get riled up, or it could be due to them being more comfortable in their position and life circumstances.

When looking at the amount of time a dog spent in the shelter and their reactions to the pumpkin and plush conditions with the researcher, the results show that the longer a dog was in the shelter the more attention seeking behavior they displayed. This is not a surprising finding, but it is an important one: When human attention is more scarce for the dogs, they do more in order to gain that attention back. Whereas when a dog in new in a shelter setting, they may not yet realize the depleted amount of attention that they will be receiving as compared to in a home. As the dog's stay in the shelter increases, they do more to gain attention from people.

For the behavioral paperwork, it was found that the level of arousal the dogs usually displayed, as well as their reactions to strangers had interacted with the living condition of the dog, in either an owner's home or the shelter. This could be due to several different factors. The first simply being that the shelter dogs were rated on their behavioral assessment by professionals with unbiased opinions; the same cannot be said for the owned dogs. The owned dogs were rated by the owner's themselves, who may or may not have had a bias interpretation of their dog's normal behavior. This could be why owned dogs were rated more favorably as compared to shelter dogs. Another explanation is simply that there is a difference in their behavior, and that the results of the behavioral evaluations reflect the true behavior of the dogs.

Without having a single rater across all dogs (owner and shelter), and doing behavioral evaluations on every dog, it is impossible to consider each dog rated equally.

When examining the level of arousal between the owned dogs and shelter dogs, in order to determine if there is a character difference between the dogs that could explain the differences in the trials, the research found that the owned dogs became more negatively aroused in play than the shelter dogs. Again, the difference could be due to character differences in the owned dogs and shelter dogs, or it could be due to the differences in raters and the possibility of a bias rating from the owners. As for a reaction to strangers, both owned dogs and shelter dogs were rated as reacted similarly where the results were determined to be non-significant.

For the current research, all of the predictions that had been made were not supported. Some of the limitations contributing to this could be the sample that was used for this research. As stated earlier, the sample that was used in the research was a convenience sample of owners and the shelter. This could have caused the dogs in this sample to have been systematically treated differently than the general population of dogs due to the higher understanding and experience of the owners. Perhaps, with a more diverse group of dogs whose owners were randomly selected could have resulted in increased findings more similar to Harris and Prouvost (2014).

This research did not find all of the same results as Harris and Prouvost (2014) did. The Chi Square results indicate that, overall there is a difference in the presence of interest and aggression that was shown towards the plush dog. When the data was broken down further to include only owned dogs for the Chi Square, the only significant findings were in the presence of interest in the plush dog condition as compared to the pumpkin. In addition, there was a marginal significance of attention seeking behavior in the owned dogs. A possible limitation of this

research is that perhaps, the fake dog that was used might not have been realistic enough. Research by Shabelansky et al. (2015) suggests that a fake dog should be treated by a canine as if it were real. In addition, research by Reid and Collins (2012) shows that dogs will treat a fake dog as a real dog. They studied reactions of dogs to both a real dog and a fake dog, and they found that if a dog was likely to react in one way to the real dog, they were just as likely to react in the same way with the fake dog. In particular, they found that dogs that displayed aggression towards the real dog would also show aggression towards the fake dog. The results of the dogs during the trials suggest that the dogs did view the plush dog as a real dog; but, there is still the possibility that the lack of movement and realistic smell could have indicated to the dogs that the plush dog was not real, therefore affecting the results in displays of interest, attention seeking, and aggression. Harris and Prouvost (2014) used a plush dog that exhibited both movement and vocalizations, therefore simulating the natural reactions of a real dog more closely. The plush dog used for this research was manipulated by the human to appear real, through the individual making the dog sit, stay, shake, and roll over. Further research could look at how a real dog receiving attention affects another dog in the room, in order to increase the external validity of the research. The lack of significant results in frequency of display of behavior in interest, attention seeking, and aggression as compared to Harris and Prouvost (2014) could be due to how the data in the two research studies was analyzed.

In addition, another limitation to this research could have been interaction with the plush dog toy ahead of the trials. Perhaps, because the plush dog was a stationary inanimate object, the dogs could have realized it was a fake dog before the start of the experiment. This could have influenced how the dogs reacted with the fake dog, where they could have been treating it as a toy as opposed to as another dog. A point against this would be that the dogs were allowed to

interact with the plush dog toy after the end of each trial in the post-interaction period, and in this time the dogs did not display any overt amount of interest, attention seeking, aggression, or over arousal towards the plush dog. In turn, they often sniffed at the abdomen and anal region of the plush dog, indicating that they believed it to be a real dog.

Another limitation of this research is the relatively small sample size. Although 41 dogs participated in the research, once the dogs were broken into their appropriate groups (owned or shelter, male or female, altered or unaltered, adult or senior), that number quickly declined. With more dogs in the study, perhaps some of the marginally significant results between groups could have been significant. Harris and Prouvost (2014) research included more dogs (37 dogs), but their research also did not section the dogs off into further groups. Perhaps, if additional studies were conducted with 40 dogs per group, those marginal results would have been significant.

Lastly, another limitation of the research pertains to the physiological data. The physiological data was collected on the two conditions: the pumpkin and the plush dog. The pumpkin condition was used as the baseline for the data. The problem is, without an actual baseline HF-HRV, it is impossible to know if the baseline HF-HRV for the dogs was higher, lower, or equal to that of the pumpkin condition. Although the results of the HF-HRV between the groups and conditions can be compared to each other, it would be best if it could be compared to a baseline position.

Harris and Prouvost (2014) analyzed their data by looking at the presence or absence of a behavior. When a Chi Square was conducted for all of the dogs in this research, significant differences in the presence or absence of interest and aggression were found. Yet, when owned dogs were examined for the presence or absence of a behavior, in order to directly replicate Harris and Prouvost (2014), the results could only partially support their research. The owned

dogs showed a significant difference in the presence or absence of interest behaviors and a marginal difference in attention seeking behaviors, but Harris and Prouvost (2014) report significant differences for interest, attention seeking, and aggression. Yet, analyzing the data in this manner seems impractical given the type of data that can be collected. In a timed study such as this one (three minutes per trial) and Harris and Prouvost's (2014) (one minute per trial), it is more prudent to record the frequency of a behavior as opposed to just the presence of a behavior. By only keeping track of the presence of a behavior, it puts a dog that displays aggression ten times on the same playing field as a dog that displays it once. This does not seem to be logical, and therefore the frequency of the behaviors is a better way to analyze this.

It seems that Harris and Prouvost's (2014) findings in their research could be accounted for by the way their data was analyzed. Although results were found in their research in interest, aggression, and attention seeking (as these were the only three they looked at), these same results were not found across the board in frequency of behavior in the current study. In fact, when examining both the Chi Square analysis and the Repeated Measures ANOVA on the owned dogs with owners, the only significant finding is in interest. As previously discussed, interest alone is not a sufficient indicator of a jealousy-like reaction, but rather it would be better if the behavior were paired with attention seeking or aggression. This is because interest by itself can be an indicator of any number of reactions, whether it is to a noise or movement that caught their gaze or an actual indication of a jealousy-like reaction. Conversely, when looking at the frequency in which a behavior is displayed, and when looking for significant differences in groups (age, sex, owned dogs and shelter dogs, etc.) many more insights can be made into the behavioral reactions of dogs in this type of situation.

Overall, the results of this research do not suggest that dogs do show jealousy-like behaviors towards resources. Most of the behavioral reactions are either in interest (which can be due to many different reasons) or over arousal (primarily in shelter dogs who are being "rude"). The results hint at the potential to find the same things as Harris and Prouvost (2014), although the ability to find this across both owned and shelter dogs suggests that potentially the relationship between the owner and dog is not essential for a reaction. The results that indicate that owned dogs show more interest towards the plush dog stimulus when the owner is with it as compared to the researcher are neutralized by the results indicating that owned dogs react to the researcher and the plush dog in the same manner as the owner and plush dog. This finding suggests that potentially a relationship is not necessary for the dogs to initially be interested in the stimulus, but the relationship may be necessary for the dogs' interest in the stimulus to be maintained. The only way to know this for certain would be to record the dog's interest in the stimulus through time. This way, it could be examined if the interest in the stimulus is due to it's novelty with the owner or researcher, and if that novelty wears off depending on the person.

In addition, the extensions implemented on this research (that Harris and Prouvost, 2014, did not do) point to physiological change in the dogs while undergoing a stressful situation, not just a behavioral reaction. In particular, the physiological change in HF-HRV was seen in the shelter dogs displaying more stress, and the owned dogs displaying more stress when the owner was in the trial as compared to the researcher.

In addition, the term of "jealousy" being redefined as being fiercely protective or vigilant of certain rights, possessions, and equality seems to be an appropriate definition given the results of the research. It appears that the results indicate that a lack of fairness that the dogs witness in the trials is what breeds a jealousy-like reaction. Given the lack of significant differences

between owned dogs and shelter dogs (albeit over arousal), and the seemingly lack of significant differences between owned dogs with the research or owner (albeit interest), it appears as though the relationship is not essential for a jealousy-like reaction to occur. Therefore, fairness is what is essential for the dogs to react, and a lack of fairness causes the dogs to become interested in the situation, and for the shelter dogs (most likely due to their rude behavior) to react in a way that attempts to fix the problem. Therefore, the current research supports the basic premise that Harris and Prouvost (2014) found, that there are differences in reactions that dogs show towards an inanimate object and another dog receiving attention. However, their definition of jealousy is not supported by the current results. More likely, the current results support the idea that jealousy is more closely related to fairness in that a jealous-like reaction due to fairness is being fiercely protective or vigilant of certain rights, possessions, and equality

The definition of jealousy in this research predicts that, regardless of the history of reinforcement that the canine has with the person in the room, the dogs will react in a similar manner to a jealousy-like stimulus. This is because the dogs are more concerned with resource distribution than they are with the relationship with the person. This is supported by the research through the owned dogs being tested with both the researcher and owner and reacting in similar ways. In addition, the owned dogs and shelter dogs reacted in similar ways to the stimuli, except that the shelter dogs reacted with more over arousal than the owned dogs most likely due to the depletion of attention as a resource. Harris and Prouvost (2014) definition of jealousy would predict that the owned dogs would react with more jealousy-like reactions than the shelter dogs because of the relationship they have with the owner. In addition, their research would predict that the owned dogs would react with more jealousy-like reactions towards the owner than the researcher. Therefore, with the current results of the research, it can be concluded that the

relationship between the canine and human is not a necessary component for a jealousy-like reaction. Some of the results indicate that the relationship could increase the reaction such as with interest, but some of the other results indicate (over arousal in the shelter dogs) that it is more likely the resource of attention that is necessary for the reaction.

References

Adams, B., Chan, A., Callahan, H., & Milgram, N. W. (2000b). The canine as a model of human cognitive aging: Recent developments. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, 24, 675-692.

Adams, B., Chan, A., Callahan, H., Siwak, C., Tapp, D., Ikeda-Jones, C., … Milgram, N. W. (2000a). Use of a delayed non-matching to position task to model age-dependent cognitive decline in the dog. *Behavioural Brain Research, 108*, 47-56.

Adler, C., Mackensen-Friedrichs, I., Franz, C., & Crailsheim, K. (2011). Social play behavior of group housed domestic dogs (Canis familiaris). *Journal of Veterinary Behavior, 6*(1), 98.

Arhant, C., Bubna-Littitz, H., Bartels, A., Futschik, A., & Troxler, J. (2010). Behaviour of smaller and larger dogs: Effects of training methods, inconsistency of owner behaviour and level of engagement in activities with the dog. *Applied Animal Behaviour Science, 123*, 131-142. doi: 10.1016/j.applanim.2010.01.003

Barrera, G., Jakovcevic, A., Elgier, A. M., Mustaca, A., & Bentolsela, M. (2010). Responses of shelter and pet dogs to an unknown human. *Journal of Veterinary Behavior, 5*, 339-344. doi: 10.1016/j.jveb.2010.08.012

Baschnagel, J. S., & Edlund, J. E. (2016). Affective modification of the startle eyeblink response during sexual and emotional infidelity scripts. *Evolutionary Psychological Science.* doi: 10.1007/s40806-016-0041-0

Bauer, E. B., & Smuts, B. B. (2007). Cooperation and competition during dyadic play in domestic dogs, Canis familiaris. *Animal Behaviour, 73*, 489-499. doi: 10.1016/j.anbehav.2006.09.006

Berntson, G. G., Bigger, J. T., Eckberg, D. L., Grossman, P., Kaufmann, P. G., Malik, M., … Molen, M. W. V. D. (1997). Heart rate variability: Origins, methods, and interpretive caveats. *Psychophysiology, 34,* 623-648.

Bollen, K. S., & Horowitz, J. (2007). Behavioral evaluation and demographic information in the assessment of aggressiveness in shelter dogs. *Applied Animal Behaviour Science, 112,* 120-135. doi: 10.1016/j.applanim.2007.07.007

Bräuer, J. & Hanus, D. (2012). Fairness in non-human primates? *Social Justice Research, 25,* 256-276. doi:10.1007/s11211-012-0159-6

Bräuer, J., Kaminski, J., Riedel, J., Call, J., & Tomasello, M. (2006). Making inferences about the location of hidden food: Social dog, causal ape. *Journal of Comparative Psychology, 120*(1), 38-47. doi: 10.1037/0735-7036.120.1.38

Buss, D. M., Larsen, R. J., Westen, D., & Semmelroth, J. (1992). Sex differences in jealousy: Evolution, physiology, and psychology. *Psychological Science, 3*(4), 251-255.

Chan, A. D. F., Nippak, P. M. D., Murphey, H., Ikeda-Douglas, C. J., Muggenburg, B., Head, E.,... Milgram, N. W. (2002). Visuospatial impairments in aged canines: The role of cognitive-behavioral flexibility. *Behavioral Neuroscience, 116*(3), 443-454. doi: 10.1037//0735-7044.116.3.443

Chaparro-Vargas, R., Dissanayaka, C., Patti, C. R., Schilling, C., Schredl, M., & Cvetkovic, D. (2014). Linear and non-linear interdependence of EEG and HRV frequency bands in human sleep. *Institute of Electrical and Electronics Engineers*.

Duranton, C., & Gaunet, F. (2016). Effects of shelter housing on dogs' sensitivity to human social cues. *Journal of Veterinary Behavior, 14,* 20-27. doi:10.1016/j.jveb.2016.06.011

Essner, A., Sjöström, R., Ahlgren, E., & Lindmark, B. (2013). Validity and reliability of Polar® RS800CX heart rate monitor, measuring heart rate in dogs during standing position and at trot on a treadmill. *Physiology & Behavior, 114*, 1-5. doi: 10.1016/j.physbeh.2013.03.002

Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Gergely, A., Abdai, J., Petró, E., Koszatolányi, A., & Topál, J. (2015). Dogs rapidly develop socially competent behaviour while interacting with a contingently responding self-propelled object. *Animal Behavior, 108*, 134-144. doi: 10.1016/j.anbehav.2015.07.024

Gosling, S. D., Kwan, V. S. Y., & John, O. P. (2003). A dog's got personality: A cross-species comparative approach to personality judgments in dogs and humans. *Journal of Personality and Social Psychology, 85* (6), 1161-1169. doi: 10.1037/0022-3514.85.6.1161

Hall, N. J., Glenn, K., Smith, D. W., & Wyanne, C. D. L. (2015). Performance of Pugs, German Shepherds, and Greyhounds on an odor-discrimination task. *Journal of Comparative Psychology, 129*(3), 237-246. doi: 10.1037/a0039271

Handlin, L., Hydbring-Sandberg, E., Nilsson, A., Ejdebäck, M., Jansson, A., & Uvnäs-Moberg, K. (2011). Short-term interaction between dogs and their owners: Effects on oxytocin, cortisol, insulin and heart rate—An exploratory study. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals, 24*(3), 301-315. doi: 10.2752/175303711x13045914865385

Harmon-Jones, E., Peterson, C. K., & Harris, C. R. (2009). Jealousy: Novel methods and neural correlates. *Emotion, 9*(1), 113-117. doi: 10.1037/a0014117

Harris, C. R. (2002).Sexual and romantic jealousy in heterosexual and homosexual adults. *Psychological Science, 13*(1), 7-12.

Harris, C. R. & Prouvost, C. (2014). Jealousy in dogs. *PLoS ONE, 9*(7). doi: 10.1371/journal.pone.0094597

Head, E., McCleary, R., Hahn, F. F., Milgram, N. W., & Cotman, C. W. (2000). Region-specific age at onset of beta-amyloid in dogs. *Neurobiology of Aging, 21,* 89-96.

Hernádi, A., Kis, A., Kanizsár, O., Tóth, K., Miklósi, B., & Topál, J. (2015). Intranasally administered oxytocin affects how dogs (*Canis familiaris*) react to the threatening approach of their owner and an unfamiliar experimenter. *Behavioural Processes, 119,* 1-5. doi: 10.1016/j.beproc.2015.07.001

Horowitz, A. (2012). Fair is fine, but more is better: Limits to inequity aversion in the domestic dog. *Social Justice Research, 25,* 195-212. doi: 10.1007/s11211-012-0158-7

Jonckheer-Sheehy, V. S. M., Vinke, C. M., & Ortolani, A. (2012). Validation of a Polar® human heart monitor for measuring heart rate and heart rate variability in adult dogs under stationary conditions. *Journal of Veterinary Behavior, 7*, 205-212. doi: 10.1016/j.jveb.2011.10.006

Kelley, N. J., Harmon-Jones, E., Eastwick, P. W., & Schmeichel, B. J. (2015). Jealousy increased by induced relative left frontal cortical activity. *Emotion, 15*(5), 550-555. doi: 10.1037/emo0000068

Kim, Y-M., Lee, J-K., Abd el-aty, A. M., Hwang, S-H., Lee, J-H., & Lee, S-M. (2010). Efficacy of dog-appeasing pheromone (DAP) for ameliorating separation-related behavioral signs in hospitalized dogs. *Canadian Veterinary Journal, 51,* 380-384.

Kis, A., Kanizsár, O., Gácsi, M., & Topál, J. (2014). Intranasally administered oxytocin decreases heart rate and increases heart rate variability in dogs. *Journal of Veterinary Behavior, 9*, e15.

Kortekaas, K., Range, F., Virányi, Z., & Kotrschal, K. (2013). Heart rate and heart rate variability of dogs (*Canis lupis familairis*) during physical and mental activities. *Journal of Veterinary Behavior, 8*, e45.

Kubinyi, E., Topál, J., Miklósi, A., & Csányi, V. (2003). Dogs learn from their owners via observation in a manipulation task. *Journal of Comparative Psychology, 117*(2), 156-165. doi: 10.1037/0735-7036.117.2.156

Kuhne, F., Höβler, J. C., & Struwe, R. (2014). Emotions in dogs being petted by a familiar or unfamiliar person: Validating behavioural indicators of emotional states using heart rate variability. *Applied Animal Behaviour Science, 161*, 113-120. doi: 10.1016/j.applanim.2014.09.020

Lane, R. D., McRae, K., Reiman, E. M., Chen, K., Ahern, G. L., & Thayer, J. F. (2009). Neural correlates of heart rate variability during emotion. *Neuroimage, 44*, 213-222. doi: 10.1016/j.neuroimage.2008.07.056

L. N. Trut, Experimental studies of early canid domestication, in: A. Sampson, J. Sampson (Eds.), The Genetics of the Dog, CABI Publishing, Oxen, UK, 2001, pp. 15-41.

Ludwig, C. (1847). Beitrage zur Kenntniss des Einflusses der Respriations bewegungen auf den Blutlauf im Aortensysteme. *Arch. Anat. Physiol. 13*, 242–3027

Maros, K., Dóka, A., & Miklósi, Á. (2008). Behavioural correlation of heart rate changes in family dogs. *Applied Animal Behaviour Science, 109*, 329-341. doi: 10.1016/j.applanim.2007.03.005

Millburn, N. (2016). When Will My Neutered Dog Calm Down? Retrieved April 15, 2016, from https://www.cuteness.com/blog/content/how-long-before-a-neutered-dog-calms-down

Ostrander, E. A. & Wayne, R. K. (2005). The canine genome. *Genome Research, 15*, 1706-1716. doi: 10.1101/gr.3736605

Pérez-Guisado, J. & Muñoz-Serrano, A. (2009). Factors linked to territorial aggression in dogs. *Journal of Animal and Veterinary Advances, 8*(7), 1412-1418.

Range, F., Horn, L., Viranyi, Z., & Huber, L. (2008). The absence of reward induces inequity aversion in dogs. *PNAS, 106*(1), 340-345. doi: 10.1073/pnas.0810957105

Reid, P., & Collins, K. (2012). Assessing conspecific aggression in fighting dogs. In: Proceedings of the AVSAB/ACVB meeting, San Diego, CA, pp. 37-39.

Riganello, F., Candelieri, A., Quintieri, M., & Dolce, G. (2010). Heart rate variability, emotions, and music. *Journal of Psychophysiology, 24*(2), 112-119. doi: 10.1027/0269-8803/a000021

Saetre, P., Lindberg, J., Leonard, J. A., Olsson, K., Pettersson, U., Ellegren, H.,… Jazin, E. (2004). From wild wolf to domestic dog: Gene expression changes in the brain. *Molecular Brain Research, 126,* 198-206. doi: 10.1016/j.molbrainres.2004.05.003

Sagarin, B. J., Martin, A. L., Coutinho, S. A., Edlund, J. E., Patel, L., Skowronski, J. J., & Zengel, B. (2012). Sex differences in jealousy: A meta-analytic examination. *Evolution and Human Behavior, 33,* 595-614. doi: 10.1016/j.evolhumbehav.2012.02.006

Shabelansky, A., Dowling-Guyer, S., Quist, H., D'Arpino, S. S., & McCobb, E. (2015). Consistency of shelter dogs' behavior toward a fake versus real stimulus dog during a behavior evaluation. *Applied Animal Behaviour Science, 163,* 158-166. doi: 10.1016/j.applanim.2014.12.001

Somppi, S., Törnqvist, H., Kujala, M. V., Hänninen, L., Krause, C. M., & Vainio, O. (2016). Dogs evaluate threatening facial expression by their biological validity--Evidence from gazing patterns. *PLoS ONE, 11*(1), 1-16. doi: 10.1371/journal.pone.0143047

Starling, M. J., Branson, N., Thomson, P. C., & McGreevy, P. D. (2013). "Boldness" in the domestic dog differs among breeds and breed groups. *Behavioural Processes, 97,* 53-62. doi: 10.1016/j.beproc.2013.04.008

Sümegi, Z., Kis, A., Miklósi, Á., & Topál, J. (2014). Why do adult dogs commit the A-not-B search error? *Journal of Comparative Psychology, 128*(1), 12-30. doi: 10.1037/a0033084

Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology. (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *European Heart Journal, 17,* 354-381.

Thayer, J. F., Ahs, F., Fredrikson, M., Sollers III, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews, 36*, 747-756. doi: 10.1016/j.neubiorev.2011.11.009

Thayer, J. F., Hansen, A. L., Saus-Rose, E., & Johnsen, B. H. (2009). Heart rate variability, prefrontal neural function, and cognitive performance: The neurovisceral integration perspective on self-regulation, adaptation, and health. *The Society of Behavioral Medicine, 37*, 141-153. doi:10.1007/s12160-009-9101-z

Thorn, J. M., Templeton, J. J., Van Winkle, K. M. M., & Castillo, R. R. (2006). Conditioning shelter dogs to sit. *Journal of Applied Animal Welfare Science, 9*(1), 25-39.

Tilley, L. P., & Smith, F. W., Jr. (2011). Blackwell's Five-Minute Veterinary Consult: Canine and Feline (5th ed.). Wiley-Blackwell.

Tod, E., Brander, D., & Waran, N. (2005). Efficacy of dog appeasing pheromone in reducing stress and fear related behavior in shelter dogs. *Applied Animal Behavior Science, 93,* 295-308. doi: 10.1016/j.appanim.2005.01.007

Udell, M. A. R. (2015). When dogs look back: Inhibition of independent problem-solving behaviour in domestic dogs (*Canis lupus familiaris*) compared with wolves (*Canis lupus*). *Biology Letters, 11*(9). doi: 10.1098/rsbl.2015.0489

Vilà, C., Walker, C., Sundqvist, A-K., Flagstad, Ø., Andersone, Z., Casulli,… Ellegren, H. (2003). Combined use of maternal, paternal, and bi-parental genetic markers for the identification of wolf-dog hybrids. *Heredity, 90,* 17-24.

Zupan, M., Buckas, J., Altimiras, J., & Keeling, L. J. (2016). Assession positive emotional states in dogs using heart rate and heart rate variability. *Physiology & Behavior, 155,* 102-111. doi: 10.1016/j.physbeh.2015.11.027

Table 1.

Background demographic information on all the dogs

Subject	Breed	Size	Sex	Alteration Status	Age	Owner/Shelter
Blue	Australian Shepherd	L	M	Neutered	7	Owner
Miley	Australian Shepherd	L	F	Neutered	8	Owner
Lucky	Golden Retriever/Mix	L	F	Spayed	11	Owner
Hooper	Labrador Retriever	L	M	Neutered	1.5	Owner
Hitch	German Shepherd/Mix	L	F	Spayed	12	Owner
Loki	Labrador Retriever	L	M	Neutered	13	Owner
Matilda	Old English Bull Dog	L	F	Spayed	4	Owner
Teddy	Retriever/Mixed	L	M	Neutered	9.5	Owner
Riley	Terrier/Mixed	S	F	Spayed	6	Owner
Lola	Golden Retriever	L	F	Spayed	2	Owner
Chipper	Golden Retriever	L	M	Neutered	9	Owner
Gibbs	Labrador/Poodle Mix	L	M	Neutered	2.5	Owner
Finnegan	Pug	S	M	Neutered	2.5	Owner
Daisy	Pug	S	F	Spayed	9	Owner
Daphne	Yorkshire Terrier	S	F	Spayed	6	Owner
Dakota	Yorkshire Terrier	S	M	Neutered	12	Owner
Lillie	Puggle	S	F	Unknown	8	Shelter
Biggaville	Pit Bull Mix	L	M	Neutered within last 30 days	1	Shelter
Micky	Schipperke/Pome Mix	S	M	Neutered	4	Owner
Mufasa	Cocker Spaniel/Poodle Mix	S	M	Neutered	5.5	Owner
M. J.	Shih Tzu/Mix	S	M	Neutered	6	Owner
Olly	Retriever/Pit Bull Mix	L	M	Neutered	1	Shelter
Tati	Pit Bull Mix	L	F	Intact	12	Shelter
Lexus	Pit Bull Mix	L	F	Spayed	8	Shelter
Kansas	Brittany Spaniel	S	F	Spayed	6	Owner
Kody	Brittany Spaniel	S	M	Neutered	4	Owner
Beatrice	Shepherd Mix	S	F	Intact	1	Shelter
Nico	Pomerarian/Poodle Mix	S	M	Neutered	11	Shelter
Kim	Shepherd Mix	L	F	Intact	1	Shelter

Wizard	Retriever Mix	L	M	Neutered	11	Shelter
Barry	Shih Tzu/Mix	S	M	Intact	4	Shelter
Lucy	Min Pin Mix	S	F	Intact	11	Shelter
Copper	Beagle/Mix	S	M	Intact	2	Shelter
Teddy	Retriever Mix	L	M	Intact	2	Shelter
Kasey	Retriever/Basset Hound Mix	L	F	Intact	13	Shelter
Charlie	Poodle	S	M	Neutered	13	Shelter
G	Chihuahua mix	S	M	Intact	8	Shelter
Titan	Pit Bull Mix	L	M	Intact	2.5	Shelter
Andy	Dachshund	S	M	Neutered	7	Shelter
Noah	Retriever Mix	S	M	Neutered	1	Shelter
Alex	Bloodhound	L	M	Neutered	3.5	Shelter

Note. Ages are shown in years. Breed size is either L (large) or S (small), and sex is either M (male) or F (female).

Table 2

Means and SD of the frequency of behavior in owned dogs and shelter dogs across conditions

	Owned dogs								Shelter dogs			
	Owner and Plush		Owner and Pumpkin		Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	11.24	5.14	9.29	4.76	10.10	5.16	9.67	4.81	15.45	6.25	13.8	3.75
Aggression	0.00	0.00	0.00	0.00	0.43	1.96	0.00	0.00	1.90	3.85	0.60	2.68
Attention Seeking	3.95	7.25	1.81	1.66	1.43	1.99	2.14	2.35	4.65	6.19	6.10	5.71
Over arousal	0.10	0.44	0.00	0.00	0.43	1.96	0.00	0.00	3.70	5.74	0.10	0.45

Note. Research question 1 is examining the differences between the owned dogs with the researcher and stimuli and the shelter dogs with the researcher and stimuli. Research question 2 is examining the differences between the owned dogs with their owners and the plush, compared to the owned dogs with their owners and the pumpkin. Research question 2 is also examining the difference between owned dogs with their owners and owned dogs with the researcher in the corresponding conditions (plush compared to plush, pumpkin compared to pumpkin).

Table 3

Means and SD of the HR and HF-HRV in owned dogs and shelter dogs

	Owned dogs								Shelter dogs			
	Owner and Plush		Owner and Pumpkin		Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HF-HRV	7.59	1.24	7.65	1.59	7.92	1.31	7.38	1.16	6.94	1.08	6.64	1.12

Note. Measured in ms^2.

Table 4

Means and SD of the frequency of behavior and HF-HRV in large and small dogs

	Small				Large			
	Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	14.95	5.89	14.15	3.76	10.57	5.97	9.33	4.47
Aggression	1.15	3.12	.00	.00	1.14	3.14	.57	2.62
Attention Seeking	2.30	3.33	3.20	4.31	3.67	5.85	4.90	5.04
Over arousal	1.60	3.60	.00	.00	2.43	5.29	.10	.44
HF-HRV	7.82 ms^2	1.26	7.26 ms^2	1.41	7.21 ms^2	1.32	6.97 ms^2	.98

Table 5

Means and SD of the frequency of behavior in male and female dogs with the researcher

	Male				Female			
	Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	12.12	6.59	12.00	5.44	13.63	5.78	11.19	3.54
Aggression	1.84	3.82	.00	.00	.06	.25	.75	3.00
Attention Seeking	2.88	3.98	4.12	5.19	3.19	5.96	4.00	4.03
Over arousal	2.68	5.09	.00	.00	1.00	3.29	.13	.50

Table 6

Means and SD of the frequency of behavior in male and female dogs with their owner

	Male				Female			
	Owner and Plush		Owner and Pumpkin		Owner and Plush		Owner and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	11.67	5.16	8.67	3.94	10.67	5.36	10.11	5.82
Aggression	.00	.00	.00	.00	.00	.00	.00	.00
Attention Seeking	1.83	1.64	1.58	1.93	6.78	10.58	2.11	1.27
Over arousal	.17	.58	.00	.00	.00	.00	.00	.00

Table 7

Means and SD of the frequency of behavior in altered and unaltered dogs with the researcher

	Altered				Unaltered			
	Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	11.90	6.08	11.10	4.93	14.91	6.50	13.27	4.03
Aggression	.93	2.86	.00	.00	1.73	3.72	1.09	3.62
Attention Seeking	3.00	5.39	3.57	4.58	3.00	2.65	5.45	5.03
Over arousal	1.40	3.67	.00	.00	3.73	6.15	.18	.60

Table 8

Means and SD of the frequency of behavior in adult and senior dogs with the researcher

	Adult				Senior			
	Researcher and Plush		Researcher and Pumpkin		Researcher and Plush		Researcher and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	13.23	5.36	12.09	3.99	12.11	7.27	11.21	5.58
Aggression	2.05	4.02	.55	2.56	.11	.46	.00	.00
Attention Seeking	2.05	2.48	4.00	4.27	4.11	6.42	4.16	5.32
Over arousal	3.68	5.69	.09	.43	.11	.46	.00	.00

Table 9

Means and SD of the frequency of behavior in adult and senior dogs with their owners

	Adult				Senior			
	Owner and Plush		Owner and Pumpkin		Owner and Plush		Owner and Pumpkin	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Interest	12.92	4.48	11.67	3.53	9.00	5.34	6.11	4.43
Aggression	.00	.00	.00	.00	.00	.00	.00	.00
Attention Seeking	5.33	9.43	2.00	1.54	2.11	1.54	1.56	1.88
Over arousal	.17	.58	.00	.00	.00	.00	.00	.00

Table 10

Means and SD of the frequency of behaviors of shelter dogs depending on the amount of time they spent in the shelter

Researcher and Pumpkin								
	Interest		Aggression		Attention Seeking		Over Arousal	
Time	Mean	SD	Mean	SD	Mean	SD	Mean	SD
.02	14.50	2.65	.00	.00	3.75	4.19	.00	.00
.03	12.20	6.02	.00	.00	5.20	4.55	.00	.00
.04	14.33	.58	.00	.00	3.67	4.73	.00	.00
.05	12.60	2.30	2.40	5.37	6.60	7.23	.40	.89
.06	16.00	*	.00	*	19.00	*	.00	*
.07	21.00	*	.00	*	8.00	*	.00	*
.08	14.00	*	.00	*	10.00	*	.00	*
Researcher and Plush								
	Interest		Aggression		Attention Seeking		Over Arousal	
Time	Mean	SD	Mean	SD	Mean	SD	Mean	SD
.02	14.00	2.94	.25	.50	4.00	2.83	3.50	7.00
.03	16.00	5.96	2.00	3.08	1.80	1.48	5.80	8.14
.04	16.30	4.73	.00	.00	2.67	2.89	1.00	1.73
.05	13.80	8.53	2.80	4.66	4.60	6.31	4.60	5.73
.06	29.00	*	.00	*	13.00	*	.00	*
.07	16.00	*	13.00	*	.00	*	5.00	*
.08	10.00	*	.00	*	24.00	*	.00	*

Note. Values with an * only had one data point, and therefore a SD could not be calculated. Time is in percentage of a year.

Table 11

Chi Square of owned dogs with their owners on the presence or absence of behaviors

		Interest with the Plush dog		
		Absence	Presence	Totals
Interest with the Pumpkin	Absence	1.00	1.00	2.00
	Presence	.00	19.00	19.00
Totals		1.00	20.00	21.00
		Aggression with the Plush dog		
		Absence	Presence	Totals
Aggression with the Pumpkin	Absence	21.00	.00	21.00
	Presence	.00	.00	.00
Totals		21.00	.00	21.00
		Attention Seeking with the Plush dog		
		Absence	Presence	Totals
Attention Seeking with the Pumpkin	Absence	4.00	4.00	8.00
	Presence	2.00	11.00	13.00
Totals		6.00	15.00	21.00
		Over Arousal with the Plush dog		
		Absence	Presence	Totals
Over Arousal with the Pumpkin	Absence	20.00	1.00	21.00
	Presence	.00	.00	.00
Totals		20.00	1.00	21.00

Figure 1. A martingale collar is a collar designed to tighten as the dog pulls on the leash. It does so through the use of a loop system, when the leash attaches to a loop in the collar. This is essential for the research for both the safety of the dog and the safety of the researcher. Use of this collar will prevent the dog from slipping its leash and getting out or injured, and it will prevent the dog to get out and potentially hurt the researcher.

Figure 2. The heart monitor that is going to be used; it will HRV. It is hands-free and worn around the dog's chest. All of the information will be transmitted via Bluetooth to an iPhone 5s to the Elite HRV app. This information will be transferred into a text file to be accessed on a computer.

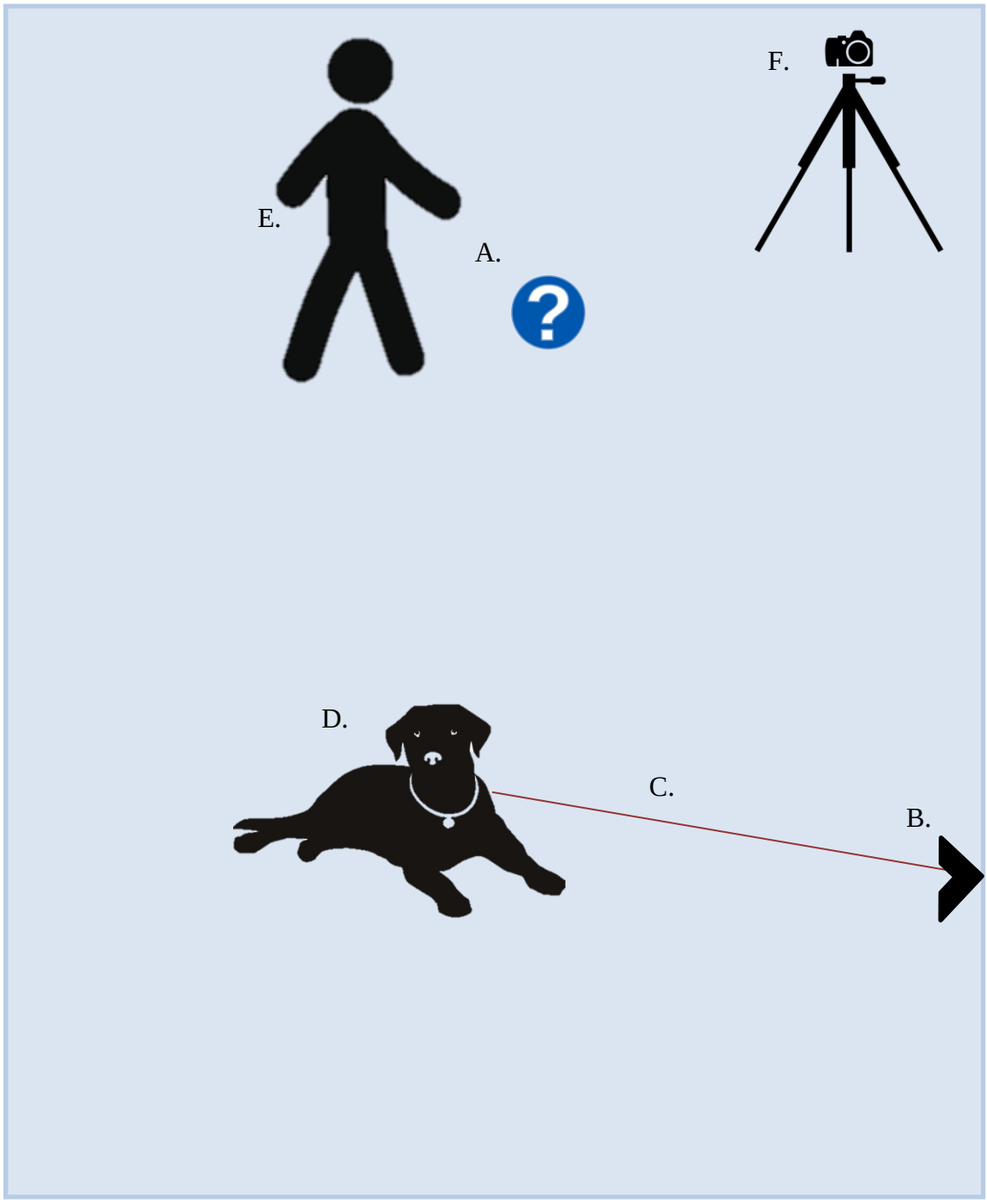

Figure 3. This is an aerial view of the experimental room layout. Each shape is labeled as follows: A.) Researcher, B.) Jealousy provoking stimuli, C.) Canine, D.) Leash, E.) Leash wall hook, F.) Camera on tripod.

HF-HRV in owned and shelter dogs in the pumpkin condition with the researcher

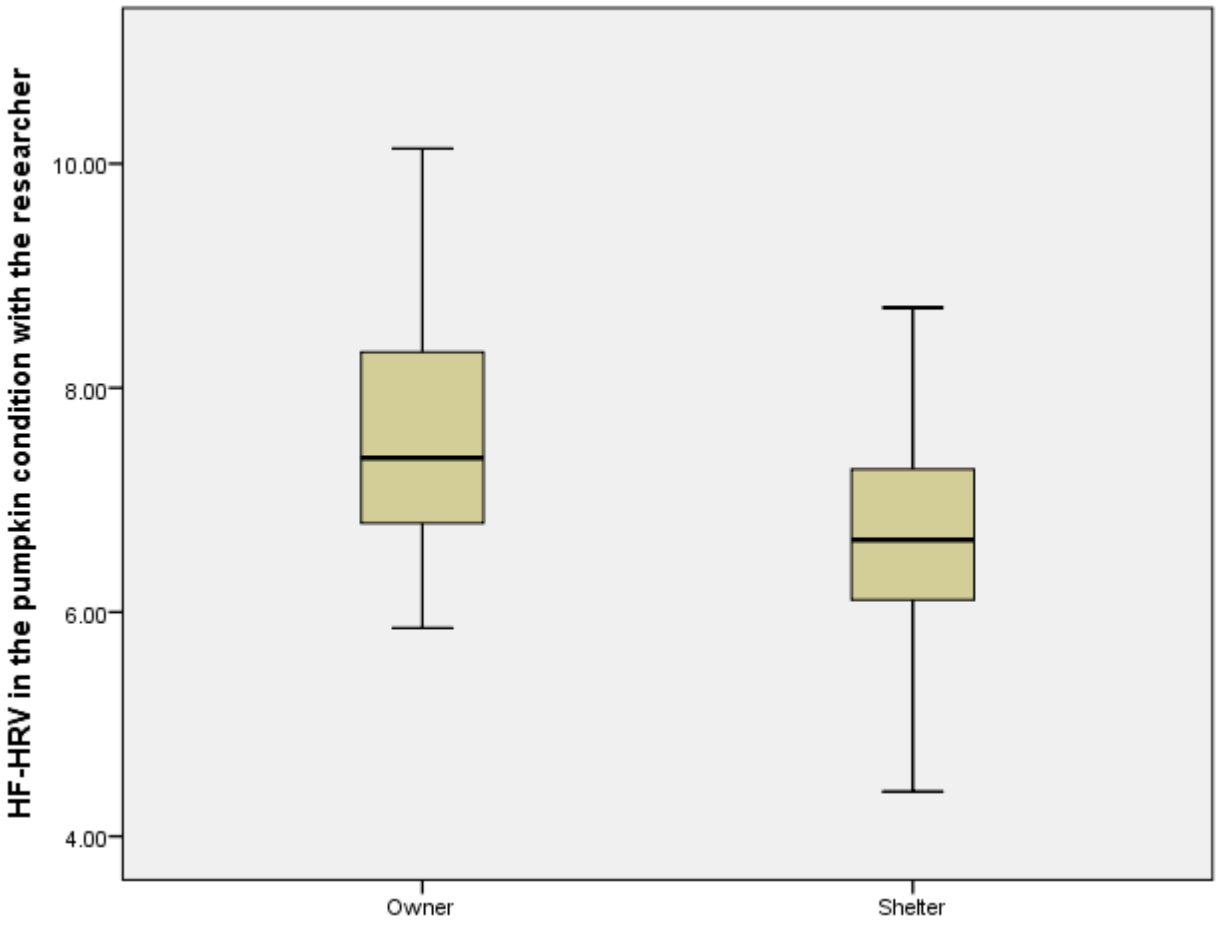

Figure 4. A boxplot of the owned and shelter dogs HF-HRV data in the pumpkin condition with the researcher.

HF-HRV in owned and shelter dogs in the plush dog condition with the researcher

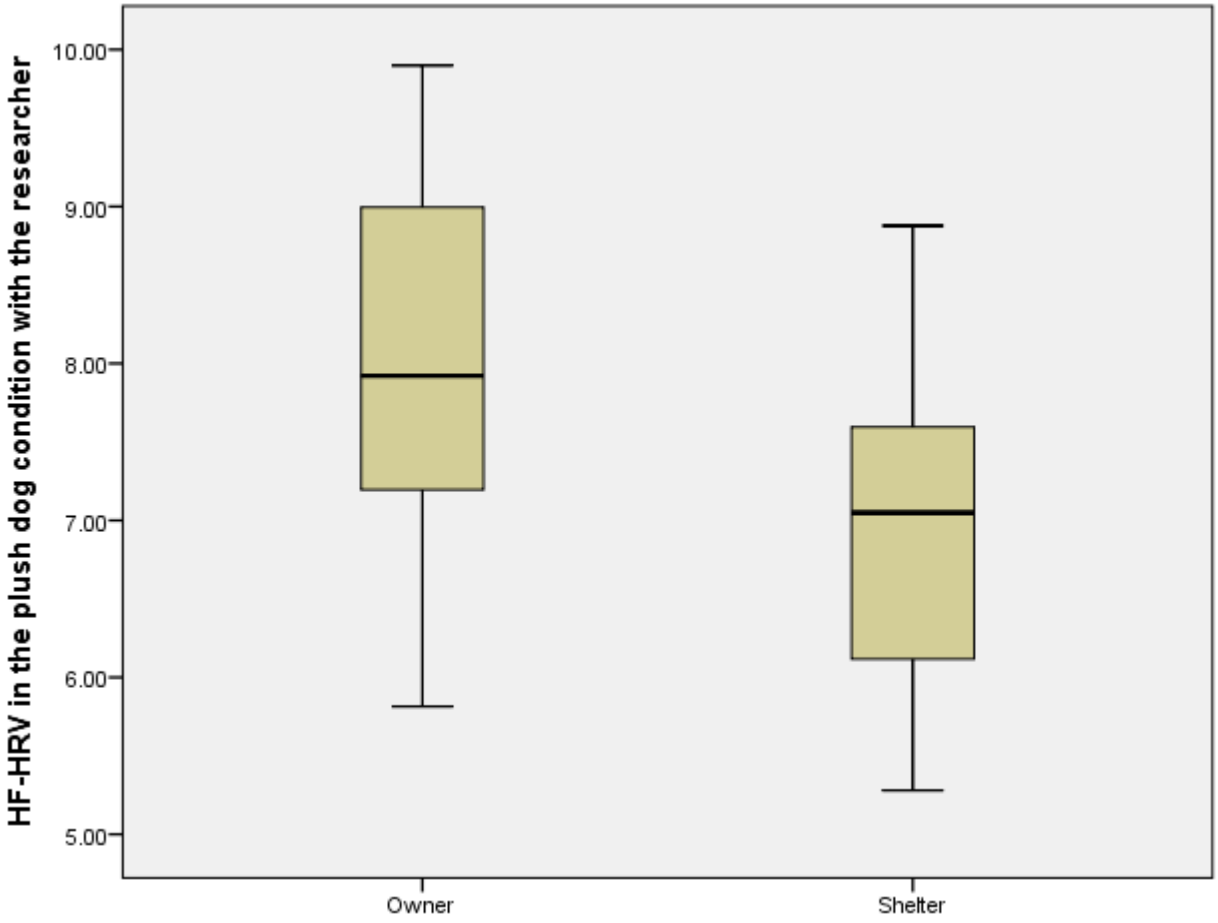

Figure 5. A boxplot of the owned and shelter dogs HF-HRV data in the plush dog condition with the researcher.

Appendix A

Canine Behavior Evaluation

Dog's Name _____ ID Number _____ Date of Test _____

Breed _____ Sex _____ Age _____ Date of Admission _____

Handler _____ Recorder _____ Time at start _____AM PM

1. Cage Presentation: Turn and face the dog, look directly into his eyes for five seconds. DO NOT threaten the dog

a. ___ Remains calm with relaxed body postures (low wagging tail, soft eye, etc.)

b. ___ Displays avoidance behaviors (turns head sideways, diverts eyes, etc.)

c. ___ Displays submissive or fearful body postures (ears back, tail down, body low, backing up, etc.)

d_____ Excited, jumps at the front of the kennel (barking, flashes teeth)

e. ___ Displays defensive aggression (growling, barking, baring teeth, while moving away)

f. ___ Displays offensive aggression (growling, barking, baring teeth, while lunging forward)

2. Sociability Test

a) Stand and Ignore for 60 seconds

___ Dog makes social contact ___ times lasting more than 2 seconds

___ Dog made "drive-by" contacts lasting less than 2 seconds at a time

___ ***Dog completely ignores handler***

Comments:_____

b) Stroke dog three times (check all that apply)

	Stroke 1	**Stroke 2**	**Stroke 3**
Dog moved away			
Dog stayed in place			
Dog moved closer			
Dog solicited more attention—calmly			
Dog solicited more attention—hyper/excitedly			
Dog completely ignored you			
Dog exhibited signs of uneasiness (shake off, whipped head, stiffened, growled, snapped)			

c) **Sit & ignore:**

___dog came over to you within 5 seconds and stayed with you the whole time

___calm ___excited ___inappropriate

(describe)_____

___ dog came over to you within 5 seconds but then moved away

___ ***dog ignored you—did not come over***

d) **20 seconds of attention:**

___ Dog comes to you and stays the entire 20 seconds

___calm ___excited ___inappropriate

(describe)_____

___ Dog comes to you but then moves away--does this repeatedly

___ ***Dog comes to you but then moves away and does not come back***

___ ***Dog ignores handler—never comes over***

5. Lip Lifts

	1st	2nd	3rd	4th	5th
Allows without struggle for 5 seconds					
Struggles slightly but allows for 5 seconds					
Struggles—allows shorter time (how long)					
Struggles fiercely—does not allow					
Pushes you away, jumps up, barks					
Stiffens, whale eye					
Whips head with open mouth, air snaps					
Growls, snarls, snaps, bites					
Other—write in what dog did					

6. **Handling Test**. Use the following scale to rate the dog's reaction to each handling exercise (record #)

1 – remains calm

2 – uncomfortable with handling - tenses up, turns head towards hand, resists by pulling away

3 – freezes, stiffens, whips around towards your hand, gives whale eye (indicate response)

4 – growls, snarls, snaps, tries to bite (indicate response)

		#	response
a.	Massage down length of body	_____	_____
b.	Run hand down his back leg and pick up hind foot	_____	_____
c.	Run hand down dog's tail and tug slightly	_____	_____
d.	Touch and look inside both ears	_____	_____
e.	Apply slight pressure to the dog's shoulders	_____	_____
f.	Walk with dog holding collar, switch directions	_____	_____
g.	Wipe body with a towel	_____	_____

7. Hug

1st Hug ___ or **other response, explain** _____

2nd Hug ___ or **other response, explain** _____

a. Relaxed, leans in, enjoys contact
b. Neutral body position
c. Cowers or collapses
d. Tenses, remains still
e. Struggles, but shows no aggression
f. Struggles fiercely, does not allow hug
g. Uneasy, whips around, yelps or barks
h. Growls, snarls, or tries to bite

After Released from Hold

After 1st hug ___ or **other response, explain** _____

After 2nd hug ___ or **other response, explain** _____

a. Remains close or in contact
b. Offers appeasement gestures
c. Climbs on handler, solicits
d. Goes to end of leash
e. Leaves, but returns quickly/when solicited
f. Squares up, barks, jumps at handler
g. Snaps or tries to bite

8. Level of Arousal - with Toys

___ Nice level of play with toys, allows handler to take toys

___ Becomes fearful and moves away

___ Showed no interest in playing

___ Quickly becomes highly aroused, but quick to calm once play ends

___ ***Becomes highly aroused (focused, intense, growls while tugging fiercely), does not calm when play ends***

___ ***Crosses over to aggression when in hyper aroused state***

___ **Possessive of toy, explain** _____

___ **Other response, explain** _____

9. Evaluate Level of Arousal - with Handler

___ Nice level of play and interaction

___ Becomes fearful and moves away

___ Shows no interest in playing

___ Quickly becomes aroused, but calms quickly once play ends

___ ***Quickly becomes aroused, focused, intense, or obnoxious (circle), does not calm when play ends***

___ ***Crosses over to aggression when in hyper aroused state***

___ **other response, explain _____**

10. Possession Test

___ Drops it readily upon request

___ Allows real or assess-a-hand to take (circle one)

___ Resists letting go, but shows no aggression

___ Avoids hand, or goes to end of leash, stiffens (circle response)

___ ***Freezes, gives whale eye, shows teeth (circle response)***

___ ***Growls, lunges, snaps (circle response)***

___ ***Bites assess-a-hand***

___ Shows no interest in any item

___ **Other response, explain _____**

11. Food Bowl Test

___ stops eating and backs away from the dish

___ continues eating but remains relaxed, shows no signs of uneasiness

___ moves muzzle deeper into the dish, eats faster—intense about food

___ Stiffens slightly or moves muzzle towards hand while eating (circle response)

___ ***Freezes and stops eating, gives whale eye (circle response)***

___ ***Growls, shows teeth (circle response)***

___ ***lunges, snaps at hand (circle response)***

___ ***bites assess-a-hand***

___ no interest in food

___ **other response**_____

12. Reaction to Strangers

___ Dog is eager and excited to meet stranger, is friendly upon solicitation

___ Dog remains calm, is friendly upon solicitation

___ Dog is nervous about stranger (ears back, tail tucked), is friendly upon solicitation

___ Dog alarm barks or growls and backs up, is friendly upon solicitation

___ ***Dog alarm barks, hackles up, growls (circle), doesn't calm readily, eventually is friendly upon solicitation but in a cautious way***

___ ***Dog alarm barks, hackles up, growls (circle), can't settle, will not approach upon solicitation***

___ ***Dog alarm barks, growls, snarls, lunges—not safe to allow approach***

___ **other response**_____

13. a. Dog to Dog test

Helper dog(s) and sex(es):_____

Reaction to other dog upon seeing him/her

#1	#2	#3	
___	___	___	remains calm—with or without interest in the other dog (circle one)
___	___	___	pulls forward to get closer to the other dog but body language remains friendly or neutral
___	___	___	becomes timid or fearful
___	___	___	***reacts with threats (barking, lunging, snarling, growling)***

b. Allow dogs to interact

#1	#2	#3	
___	___	___	totally ignored other dog
___	___	___	neutral, sniffs appropriately
___	___	___	relaxed and friendly with other dog
___	___	___	invited play (play bow, pawing, friendly bark or whine, etc.) (circle)
___	___	___	displayed fearful behaviors (lowered body, tail tucked, ears down, rolled over) (circle)
___	___	___	displayed rude/assertive behaviors (placing head or paw on other dog's back, mounting)
___	___	___	***displayed defensively aggressive behavior (bared teeth, growling, lunging) (circle)***
___	___	___	***displayed offensively aggressive behavior (bared teeth, growling, lunging) (circle)***

Recommendations:

Appendix B

Owner's Behavioral assessment Form

Dog's Name _____ Date of Test _____

Breed _____ Sex _____ Age _____

Time at start _____AM PM Length of time owned _____

1. Level of Arousal - with Toys

___ Nice level of play with toys, allows handler to take toys

___ Becomes fearful and moves away

___ Showed no interest in playing

___ Quickly becomes highly aroused, but quick to calm once play ends

___ ***Becomes highly aroused (focused, intense, growls while tugging fiercely), does not calm when play ends***

___ ***Crosses over to aggression when in hyper aroused state***

___ **Possessive of toy, explain** _____

___ **Other response, explain** _____

2. Reaction to Strangers

___ Dog is eager and excited to meet stranger, is friendly upon solicitation

___ Dog remains calm, is friendly upon solicitation

___ Dog is nervous about stranger (ears back, tail tucked), is friendly upon solicitation

___ Dog alarm barks or growls and backs up, is friendly upon solicitation

___ ***Dog alarm barks, hackles up, growls (circle), doesn't calm readily, eventually is friendly upon solicitation but in a cautious way***

___ ***Dog alarm barks, hackles up, growls (circle), can't settle, will not approach upon solicitation***

___ ***Dog alarm barks, growls, snarls, lunges—not safe to allow approach***

___ **other response**_____

Appendix C

Background information

Dog's Name _____ Date of Test _____

Breed _____ Sex _____ Age _____

Circle one Shelter dog or Owner's dog

1. Has the dog experienced any health issues that required veterinary care in the last 7 days? If so, explain.
2. How long has the owner or shelter had the dog?
3. How was the dog acquired by the owner or the shelter?

Appendix D

Provoking Stimuli Script

Acceptable phrases to say during the conditions:

- “Good dog”
- “Good boy/girl”
- “Look at how pretty/handsome you are!”
- “Who’s a good dog?”
- “Who’s a good boy/girl?”
- “You’re a sweet boy/girl!”
- “Who’s a pretty/handsome dog?”
- “Who’s a pretty/handsome boy/girl?’
- “Are you a good boy/girl?”
- “Are you a good dog?”
- “Look who’s spoiled!”

Appendix E

Canine Behavioral Research Consent Form

You are being asked to take part in a research study of canines react to jealousy provoking stimuli. Please read this form carefully and ask any questions you may have before agreeing to take part in the study.

What the study is about: The purpose of this study is to learn how dogs react to various jealousy provoking stimuli. Your dog must be at least 1 year old in order to participate in this research.

What we will ask you to do: If you agree to be in this study, we will meet you at your house to conduct the trials. We ask that you fill out a short questionnaire on the behavioral assessment of your dog. We ask that you feed your dog at between 7:00 and 8:00 (if possible), and that we be allowed to start trials between 11:30 and 12. We ask that you participant in two of the trials: one for the neutral condition, and one as the person inducing the jealousy. This simply involves you paying attention to a stuffed dog as if it were a real dog. In total, the trials should not take more than an hour to complete. With your permission, we would also like to video record the trials for later coding.

Risks and benefits:

I do not anticipate any risks to you participating in this study other than those encountered in day-to-day life.

There are no benefits to you. We hope to learn more about displays of jealousy-like behavior in canines.

Compensation: You will be entered into a raffle to win a 100 dollar gift card to Petsmart.

Taking part is voluntary: Taking part in this study is completely voluntary. If you decide not to take part, you are free to withdraw at any time.

If you have questions: The researcher conducting this study is Cassie Beck, and she is being supervised by Dr. John Edlund. Please ask any questions you have now. If you have questions later, you may contact Cassie Beck at cdb8853@g.rit.edu or at 570-772-7897, or you may contact Dr. John Edlund at jeegsh@rit.edu. If you have any questions or concerns regarding the treatment of your dog in this study, you may contact the Institutional Animal Care and Use Committee (IACUC) through Larry Buckley (ljbsbi@rit.edu).

You will be given a copy of this form to keep for your records.

Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

In addition to agreeing to participate, I also consent to having the interview tape-recorded.

Your Signature _____ Date _____

Signature of person obtaining consent _____ Date

_____

Printed name of person obtaining consent _____ Date

_____

Appendix F

Video Rating Sheet

Place a tally mark in the box to indicate the number of times that behavior is displayed.

Dog #: Sex:	**Condition 1**	**Condition 2**	**Condition 3**	**Condition 4**
Interest				
Aggression				
Attention Seeking				
Over arousal				

Aggression. Aggression will be characterized by any attempt the dog shows to bite or nip at the stimulus, especially when associated with lip curling or teeth bearing.

Attention seeking. Attention seeking behavior is any act of the dog to gain the researcher's attention. This can include pushing the researcher, pushing the stimulus, attempting to place themselves between the interaction with the researcher and the stimulus, or making vocalizations during the trial.

Interest/attention. Interest is the amount of time the dog looked with head turned and gaze directed at the researcher, looked with head turned and gaze directed at the stimulus, and orientated head and body towards the stimulus.

Over arousal. Any attempt by the dog to be in charge of the stimulus, such as placing front paws on the stimulus and standing rigidly or performing simulated intercourse ("humping").

Please make any comments of the behavior of the dog that may have seemed unusual.

Condition 1:

Condition 2:

Condition 3:

Condition 4: