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Sarah Scott returned to Bridgewater State University to study psychology after completing a Bachelor of Science in Business Management from Bridgewater in 2008. She spent the summer of 2012 conducting a research study that investigated visual communication in domestic dogs. She was mentored by Dr. Amanda Shyne of the psychology department. Her project was supported by the Adrian Tinsley Program summer research grant and was presented at Bridgewater State University's 2012 Undergraduate Summer Research Symposium and the 2013 National Conference on Undergraduate Research in LaCrosse, Wisconsin. Sarah was awarded a Bachelor of Science in Psychology in January 2013 and now works as a lab manager in the Cognitive and Affective Neuroscience Laboratory in the psychology department at Boston College. She continues to be enthusiastic about research and plans to pursue a graduate degree.

The unique phylogenetic and ontogenetic history of domestic dogs has had an effect on the way they communicate with one another. Research suggests that domestic dogs' ability to communicate through visual signals may vary by breed (Goodwin, Bradshaw, & Wickens 1997; Kerswell, Bennet, Butler, & Hemsworth 2009). In the current study, we investigate the effect of a visual communication signal, the look away, observed in both domestic dogs and their ancestor, the wolf, in order to examine whether or not domesticated dogs respond to this visual signal. Research indicates that domestic dogs respond appropriately to artificial dog models (Leaver & Reimchen, 2008). Therefore, we allowed live domestic dogs to approach an artificial model dog as it "looked away," turning its head approximately 45% to the left, from the approaching live dog participant. In order to reveal any pattern of behavioral responses among domestic dogs to the look away behavior, the observable behavior displayed by the live dog participant (in the moments following the model dog's look away) was recorded on video. Slow-motion review of the footage revealed that 36% of live dogs displayed some type of observable behavior (ranging from a brief break in eye contact to a blatant turn away from the model dog) after seeing the model dog look away, while 64% of live dogs displayed no observable behavior after seeing the model dog look away. A larger percentage of large dogs (dogs larger than the model dog) appeared to avert their gaze or look away after observing the model dog look away, and a larger percentage of small dogs (dogs smaller than the model dog) showed no observable response after observing the model dog look away. Goodwin et al. 1997 investigated the use of wolf-like visual signals in 10 breeds of domestic dog, rated according to their physical similarity to the wolf by a group of dog behavior counselors. It was found that wolf-like visual signals were observed less frequently in domestic dogs that are less wolf-like in their physical appearance. Dogs rated least wolf-like in their appearance also happened to be the smallest breeds examined in the study, while dogs rated as the more wolf-like in their appearance were larger in size. Using size as a heuristic indicator of physical similarity to the wolf, our data may indicate a possibility that less wolf-like domestic dogs may also respond to wolf-like visual signals less frequently.

While humans may understand many communication behaviors of domestic dogs, we often struggle in our understanding of dog-dog communication. Pet owners are not necessarily highly skilled in interpreting the communication behaviors that domestic dogs direct at each other (Tami & Gallagher, 2009). Pat Goodman explains, in the forward of *On Talking Terms with Dogs:*

Calming Signals by Turid Rugaas, that in our attempt to decode the "language" of domestic dogs, the behavior of wolf packs is often used as a model (Rugaas, 2006). While our knowledge of the social behaviors of wolves may be important for our understanding of domestic dog communication behaviors, there is research that suggests differences in domestic dog morphology may have an effect on their communication signals (Feddersen-Petersen, 2000; Goodwin et al., 1997; Kerswell et al., 2009; Kerswell, Butler, Bennett, & Hemsworth 2010; Leaver & Reimchen, 2008; McGreevy & Nicholas, 1999). Due to the physical effects of paedomorphosis (the retention of juvenile features into adulthood), the vastly different, novel morphologies of various breeds, and the popularity of certain features such as clipped ears and docked tails, many dogs are physically unable to use the same visual communication signals that wolves do. Recent research suggests that their repertoire of wolf-like visual communication signals is, consequently, shrinking (Goodwin et al., 1997). Goodwin et al. 1997 investigated the visual communication signals of 11 different domestic dog breeds, each rated by a group of dog behavior counselors as to their physical similarity to the wolf, measured by: "length of muzzle, eyes, shape of ears, ability to move ears, coat, tail, overall proportions of head and body, and ability to alter the height of the back from the ground" (Goodwin et al., 1997, pp. 300). The study demonstrated that as physical similarity to the wolf decreased so did the display of wolf-like visual signals (Goodwin et al., 1997). It has been suggested that domestic dogs now communicate with each other through other avenues due to the fact that visual communication is unreliable (Goodwin et al., 1997; Kerswell et al., 2009). Audition and olfaction have both been proposed as communication methods for domestic dogs (Feddersen-Petersen, 2000; Goodwin et al., 1997; Kerswell et al. 2009; Serpell, 1995; Wickens, 1993 as cited in Kerswell et al., 2009). It is possible that dog communication abilities may vary along with their morphology, as different breeds appear to have different visual signal repertoires (Goodwin et al., 1997; Kerswell et al., 2009). At the present time, we are unaware of any evidence of domestic dogs' ability to receive and respond appropriately to the visual signals that they fail to display themselves (Goodwin et al., 1997). Our goal is to take the first step in an attempt to investigate this. Some clarification of the ability of domestic dogs to respond appropriately to the visual signals of other breeds would be of great value in our understanding of domestic dog communication. This information is important for pet owners, patrons of popular dog parks, animal shelter facilities, and dog day care facilities, where domestic dogs of all shapes, sizes, and breeds are in close proximity and may run the risk of misunderstanding or ignoring important communication signals.

For the current study, we observe the responses of domestic dogs to a wolf-like visual signal. The motion of "looking away," avoiding eye contact and turning the head away from the other animal, has been identified in wolf ethograms as an act of submission (Fox, 1970 as cited in Goodwin et al., 1997), and has also been observed in the grey fox, another wild canid (Fox, 1969). M. W. Fox's explanation of this behavior in the domestic dog is similar to the submissive gesture in the wolf; a behavior displayed when the dog is in the presence of a dominant conspecific, or when the dog is in an anxiety-provoking situation (Fox, 1969). More recently, the look away behavior continues to be described as a display indicating the dog is uncomfortable or in a conflict situation that they wish to abate (Coren, 2000; Rugaas, 2006). In Stanley Coren's, *How to Speak Dog*, "eyes turned away to avoid direct eye contact" indicates "a signal of submission, with some undertones of fear" (Coren, 2000, pp. 260). These interpretations of the behavior imply that domestic dogs use this signal in a similar manner as wolves. Considering the observed differences between wolf social behavior and domestic dog social behavior (Feddersen Petersen, 1991 as cited in Feddersen-Petersen, 2000), and the variability in domestic dog communication, is it correct to assume that all domestic dogs interpret the look away in a similar manner, if at all?

We gathered evidence of the typical response of domestic dogs to the look away behavior through the use of a robotic, artificial model dog. Animal communication researchers often use robotic animal models in order to send and elicit messages from live animals of interest (Knight, 2005; Leaver & Reimchen, 2008; Young, 2007). Findings in Leaver & Reimchen, 2008, suggest that domestic dogs respond appropriately to artificial models. For this study, we used a realistic model dog with a remote control operated microcontroller and servo motor placed inside the neck. At Peter's Park Dog Park in Boston, MA, we allowed live dogs to approach the model dog and, via remote control, the model dog looked away from the approaching live dog. The behavioral response of the approaching live dog was recorded.

METHODS

Subjects

Participants included all pet dogs present at Peter's Park Dog Park (Boston, MA) that, with their owners' permission, voluntarily entered the pen containing the model dog. Dogs that did not willingly enter the pen, dogs on a leash being held by the owner, and dogs that clearly did not look in the direction of the model dog were not included. A total of 61 dogs from various breeds were recorded. Identifying information, including the dogs' breed, was not recorded.

Apparatus

A stuffed dog resembling a golden retriever, 14 inches tall at the shoulder, was used as the model dog. PVC pipes (1/2") were placed inside among the stuffing to act as a frame. A small motor (HS-422 Delux Servo) was attached to the PVC pipe inside the neck area and an attached microcontroller (Arduino UNO Rev3) was placed inside the shoulders. The head of the stuffed dog was attached with industrial strength Velcro to a plastic disc that was screwed, securely, onto the top of the motor. A small IR receiver (to receive the signal from the remote control), attached to the microcontroller inside the shoulders, rested at the back of the dog's neck. The microcontroller was programmed such that, with the push of the remote control button, the motor turned the disc, with the dog's head attached, to a position 45 degrees to the left. The fur surrounding the neck area effectively covered the small motor and muffled its sound, and the remote control was effective from up to 15 feet away. These factors increased the realistic nature of the model and its look away behavior.

Data Collection/Procedure

Data were collected in six sessions, the first on July 10, 2012 and the last on July 26, 2012. Sessions were held on both weekdays and weekends. They ranged from one to three hours long and took place at different times during the day: early morning from 7:00-10:00am (July 26), mid morning from 10:00-11:30am (July 12), early afternoon from 1:30-3:00pm (July 10), late afternoon from 2:45-5:30pm (July 13), early evening from 5:00-7:45pm (July 15), and evening from 7:15-9:15pm (July 17). All data collection sessions took place at Peter's Park Dog Park located in Boston, MA. A small area, approximately 6 x 11 feet was sectioned off in the corner of the park with an approximately 2.5 ft. tall plastic fence. The fence was covered with dark plastic in order to deter potential participant dogs from looking inside the pen before entering. The model dog was positioned inside the pen, approximately 8 ft. from the pen's entrance, with head and body facing the pen's entrance, "looking" directly at the entering live dog participant (see Figure 1). Interested dog owners brought their dog to the entrance of the pen where the door was opened for the live dog to enter. When the live dog stepped approximately 1 foot past the entrance of the pen (as indicated by a marker), the remote control was used to turn the dog model's head approximately 45 degrees to its left, "looking away" from the approaching dog. The dog participant was observed and filmed on a Sony XR150 or a Cannon Vixia HV40. Any obvious, distinct behavior of the live dog seen in the moments after observing the model dog's look away was recorded on a data sheet. After recording this information, an instant photo was taken of the live dog participant with a Fujifilm Instax210 instant camera, and the photograph was attached to the data sheet. This was done in order to correctly identify each live dog participant in the video footage and to ensure that each dog was recorded only once. The video footage was carefully reviewed and all live dogs' behavior in the moments immediately following the observation of the model dog's look away behavior fell into one of two categories. A percentage of dogs averted their gaze from the model dog for a brief moment after observing the model dog's look away behavior and were categorized as dogs that "looked away." The behaviors of dogs that fell into the look away category included momentary breaking of eye contact, sometimes only visible in slow motion (or frame-by-frame) review of the tape. Some dogs in this category blatantly turned their head away and paused or withdrew. Dogs that did not look away from the model dog after observing the model dog's look away behavior showed no observable behavioral response in the moments after observing the model's behavior and were categorized as such. Any behaviors that occurred after the moments following the observation of the model dog's look away, such as sniffing, making contact with the model, or leaving the enclosed area that housed the model dog, were not recorded.

Figure 1. The Artificial Model Dog's Pen

It is important to note that some of the live dog participants appeared to lower their heads slightly at some point during their entrance into the pen or during their approach toward the model dog. This was not recorded or included in data analysis due to the fact that the angle of the camera made it impossible to determine if the head lowering was an intentional visual signal or merely an effect of the dogs' natural gait. Dogs that lowered their heads enough such that they averted their gaze away from the model dog were counted in the "look away" category.

Figure 2. Model Dog First Looking Toward Approaching Live Dog (top), And Then Performing the Look Away Behavior (bottom)

Table 1. Percentage of Participating Live Dogs Who Displayed an Observable Look Away Behavior After Seeing the Look Away of the Artificial Dog Model, Separated by Size

Size (In Relation to Clancy)	Look Away	No Observable Change	Totals
Smaller	22.7%	77.3%	100%
Similar	30%	70%	100%
Larger	55.6%	44.4%	100%
Totals	36%	64%	100%

Table 2. Number of Participating Live Dogs Who Displayed an Observable Look Away Behavior After Seeing the Look Away of the Artificial Dog Model, Separated by Size

Size (In Relation to Clancy)	Look Away	No Observable Change	Totals
Smaller	5	17	22
Similar	3	7	10
Larger	10	8	18
Totals	18	32	50

RESULTS

Of the 61 dogs, 11 were eliminated from data analysis. Six dogs did not see the model dog's look away behavior, as noted by slow motion review of the video footage. Four live dogs were eliminated due to insufficient reviewable footage, and one dog was eliminated because review of footage revealed that the model dog did not turn its head.

The behaviors of the remaining 50 dogs, displayed in the moments after they observed the model dog's look away, fell into one of two categories: 18 live dogs looked away from the model dog, and 32 live dogs showed no observable behavioral change in their approach (see Table 1). Live dogs that looked away from the model dog displayed behaviors ranging from a brief (only visible in slow-motion review of footage) break in eye contact, to a blatant turn of the head away from the model dog. Some of the dogs in this category with the most distinct observable behaviors paused briefly or withdrew, while others showed no change in their speed of approach. All live dogs in this category averted their gaze away from the model dog at some point in the moments following the model dog's look away behavior. Overall, 36% of all live dog participants displayed an observable behavior (looked away) after seeing the model dog look away, while 64% of participants showed no observable behavior (see Table 2). When separated by size (dogs that appeared smaller than the model, the same size as the model, or larger than the model), the data shows that 22.7% of the small dogs looked away after observing the model dog's look away while 77.3% of small dogs showed no observable behavior, 30% of dogs the same size as the model looked away after observing the model's look away while 70% showed no observable behavior, and 55.6% of large dogs looked away after observing the model's look away behavior while 44.4% showed no observable behavior change.

DISCUSSION

The goal of this study was to observe responses to the look away behavior in domestic dogs, in order to find any evidence of the "understanding" of wolf-like visual communication behaviors. We use understanding here to mean that the dog observing the visual communication behavior displayed by another dog responds appropriately and accordingly to what previous research suggests the visual signal reveals about the signaling dog's internal state. Popular belief and anecdotal evidence suggest that the look away is an act of submission, displayed when the domestic dog is uncomfortable with the situation. The model dog in this study was in an enclosed pen, and was approached by an unknown dog. When the model dog turned its head to look away from the approaching live dog participant, 64% of the time, the live dog continued to approach the model dog, with no discernable response to the visual signal that they observed.

An interesting explanation for this pattern of behavior is that some domestic dogs may understand and respond to the look away, while others do not. As discussed earlier, Goodwin et al. 1997, demonstrated that as wolf-like physical features decreased, so did the display of wolf-like visual signals. In Goodwin's study, the smallest of the dog breeds that were observed (such as the King Charles Spaniel, Norfolk terrier, and French bulldog) were rated the least wolf-like. These were also the dog breeds that displayed the fewest wolf-like visual communication signals out of the breeds that were observed. Our data indicate that the smallest dogs of our study were the least likely to respond in any observable way to the look away behavior of the model dog (22.7% look away, 77.3% no observable response). Slightly more medium sized dogs responded to the look away (30% look away, 70% no observable response). Large dogs responded most often in some observable way to the look away behavior (55.6% look away or look away and pause, 44.4% no observable response) suggesting that they may have been the most likely to understand that the model dog's signal indicated an uneasiness about being approached.

It is also possible that we observed a response in only 36% of live dogs because the majority of live dogs realized that the dog they were interacting with was a model. Despite the small percentage of obvious responses to the look away behavior, live dogs appeared to respond appropriately to the model dog during their initial approach. Some canine patrons at the dog park investigated the model dog during the experiment set-up and attempted to elicit play from the artificial model dog, or barked when the model was "looking" at them. Our experience was consistent with experience of other researchers that domestic dogs respond appropriately to artificial model dogs (Leaver & Reimchen, 2008). Therefore, while it is possible that the live dogs knew the model dog was not real, we do not believe this was the case. All of the live dogs seemed to respond to the model dog as though he were, in fact, real.

It is important to note that the percentage of participating live dogs who displayed an observable behavior (36%) may be somewhat inflated, as we chose to include dogs in this category even if their look away was so quick that it was only visible in slow motion review of the footage and not seen in real time during data collection. This is important in terms of our understanding of domestic dog visual communication signals. It may be even more difficult for humans to observe accurate patterns in the behavior of domestic dogs if they are too quick to be seen in addition we have no way of knowing if other dogs are capable of discerning the behavior.

Our data are consistent with other studies that, together, suggest wolf-like visual communication signals are disappearing from the repertoires of domestic dogs as they become less and less wolf-like in their physical appearance. Further research is essential for more definitive answers regarding the use of visual communication signals in domestic dogs. We hope that future studies will investigate responses to the look away and other visual communication signals observed in domestic dogs in order to increase our understanding of how visual signals are displayed and received among dogs with varying visual signal repertoires.

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