2014-06-01

Social Referencing in Domestic Dogs: The Effects of Human Affective Behavior on Canines Point Following

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Affective Behavior on Canines Point Following

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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June 2014

Abstract

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A number of studies have examined the ability of dogs (*Canis Familiaris*) to follow human given cues. Dogs have been shown to reliably follow pointing cues. To date, few studies have investigated whether emotional cues are a factor in these canine choices. We tested dogs using a two-way object choice food task. Sixty large and medium breed dogs were tested in one of four conditions (positive baited, silent baited, negative non-baited and negative baited). Results showed that dogs reliably followed human pointing cues over emotional cues in three of the four conditions. In the negative non-baited bowl, dogs did not select the non-indicated, baited bowl over chance. This suggests that canines use pointing as a more salient cue than emotions in object choice tasks.

Keywords: canines, affect, cue following

ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to my advisor, Ross Flom, Ph.D. for his unwavering support and kindness. I would also like to thank my committee members, Sam Hardy, Ph.D. and J. Dee Higley, Ph.D. for their support. I would like to thank Will West, Darren Guenther, James Parker and Chantelle Fitting for their invaluable assistance and Darren J. Garcia for his camaraderie and encouragement. Finally, I'd like to give a special thanks to my husband, John Gartman and my children, Emily and Todd, for their confidence and faith in me. Words cannot express how grateful I am to each of you for your personal and professional assistance.

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Communication is essential for the survival of nearly every species. Communication promotes the obtaining of resources, avoiding of predation, and in higher order mammals promotes social and cognitive development (Hauser, 1997). While several primate species (i.e., chimpanzees and great apes) are genetically closer to humans, humans and dogs (*Canis familiaris)*, have shared a longer and more mutually beneficial social relationship. Research indicates that domestic dogs and humans have co-existed between 10,000 to 14,000 years and one consequence of this long-standing association is an increased level of communication and sharing of information across these two species (Hare & Tomasello, 2005).

According to Hare and Tomasello (2005) this prolonged association between dogs and humans facilitated the evolution and emergence of human-canine communication. In addition to shared interactions, various breeding practices that advanced domestication may have contributed to, and promoted increased communication between dogs and humans (see Trut, 1999 for a review). It's also possible that dog's sensitivity to human communicative cues (such as pointing) were a result of natural selection of those dogs that interacted with humans. Whether selective breeding led to canines' ability to read human communicative behaviors, or whether canines initially demonstrated sensitivity to human communicative behavior, which subsequently led to, the selection or breeding of this trait remains an open question and is beyond the scope of this thesis. Still, it is likely that processes of shared interaction and domestication co-acted throughout evolution rather than one process preceding the other. While processes of domestication and shared interactions may have increased canines' ability to read our communicative cues, it is also probable that humans too have developed, over an evolutionary time scale, sensitivity and responsiveness to various canine behaviors. Thus the capacity for canine-human communication is likely a product of both convergent evolution and domestication.

Following Points

One commonly used communicative behavior human infants engage in is joint visual attention, i.e., looking where another is looking. The act of looking where another is looking is important because another's pointing gesture, as well as an adult's direction of head and eye-gaze can be used to guide infant exploration, share information between adult and child, and promote a shared awareness about a particular object or event. Around 9-months of age human infants reliably follow an adult's pointing finger toward a location that is not immediately visible to the infant (Butterworth & Cochran, 1980; Flom, Deak, Phill, & Pick, 2004). Interestingly, chimpanzees and great apes - who are among our closest genetic relatives - show a limited ability to follow a human's pointing gesture even after considerable training (Call, Agnetta, & Tomasello, 2000; Tomasello, Call, & Gluckman, 1997).

In comparison to non-human primates, dogs show a robust ability to follow and use a human's pointing gesture to discover the location of a hidden food item and typically do so after 1-2 warm-up trials. For example, Lakatos, Soproni, Dóka, and Miklósi (2009) compared human infants and dogs' ability to follow different pointing gestures. In this experiment the researchers placed either a piece of food or a toy in one of two bowls on the floor and pointed using several different types of points (long cross-pointing, forward cross-pointing and elbow cross-pointing). Their results indicate that 2- and 3-year olds and dogs were successful at following the long cross-pointing and the forward cross-pointing gestures in retrieving the toy or food, however dogs and children younger than two were unable to follow the elbow cross-pointing gesture. A follow-up experiment investigated whether dogs and human infants were able to generalize using familiar pointing gestures and unfamiliar ones (i.e., pointing with the foot, elbow, knee, etc.). Results revealed "all subjects, including canines, were successful in finding the objects with familiar gestures (pointing with a finger and outstretched arm) and some unfamiliar gestures (pointing with one's leg), but only older children were able to comprehend pointing with the knee" (Lakatos et al., 2009).

Research also shows that dogs comprehend the pointing gesture as referential. That is, when the human experimenter establishes eye contact with a dog prior to pointing to a food container in a two object choice task, dogs reliably follow the adult's pointing gesture. However when a similar pointing cue is given, but eye contact between the dog and experimenter is not established, dogs do not follow the point/gesture above chance (Kaminski, Schulz, & Tomasello, 2012). In other words if dogs simply associate a pointing finger with a piece of food they should always follow the pointing finger. However, as the above example illustrates, dogs only followed the experimenter's point when it was clear that point was in reference to a specific object/location and that the dog was to attend to the experimenter (i.e., establish eye-contact). Finally, dogs also follow points even in the face of contradictory cues. McKinley and Sambrook (2000) demonstrated that dogs reliably follow a human's pointing gesture to the correct location even when the experimenter walks toward, and stays near the incorrect location, but points to a more distally located target. Thus dogs, like human infants, are sensitive to, and follow human pointing gestures (see Lakatos, Gácsi, Topál, & Miklósi, 2012; Miklósi, Polgárdi, Topál, & Csányi, 1998; Udell, Dorey, & Wynne, 2008; Udell, Giglio, & Wynne, 2008 for other examples of canine sensitivity to human pointing).

Canine Sensitivity to Facial Expressions

Just as dogs are sensitive to and follow a variety pointing gestures, canines are also sensitive to more subtle cues such as a human's facial expressions. Bruce and Young (1998) for example, note, "the recognition of human facial features by humans conveys meaning about gender, age, intention and mental state". Therefore the ability to recognize facial cues and respond accordingly plays an important role in communication. While a vast literature exists examining humans, including human infants proclivity for face perception and recognition, until recently it was unknown as to whether dogs discriminate and recognize the faces of other dogs as well as the faces of humans. In a recent experiment Racca et al. (2010) investigated whether dogs discriminate the faces of other unfamiliar dogs as well as they discriminate human faces. Using a visual paired-comparison procedure they revealed that dogs show reliable discrimination of individual human faces as well as dog faces (Racca et al., 2010). In a related study, dogs were either shown a set of paired pictures of their owners paired with a stranger, or a picture of their owner smiling paired with their owner showing a blank expression (Nagasawa, Murai, Mogi, & Kikusui, 2011). These results revealed, like Racca et al. (2010), that dogs show a reliable preference for their owner's face over the stranger's face, and dogs looked longer to their owner's smiling face compared to the owner's expressionless face. Findings such as these indicate dogs are adept at discriminating faces, prefer a familiar face to an unfamiliar face, and show a preference for a positive (i.e., smiling) expression over an expressionless face. While discriminating faces is an important social, cognitive, and of course communicative behavior, equally important is the ability to use another's communicative gestures for guiding one's behavior.

Canine Sensitivity to Other Types of Cues

If dogs are indeed social animals, and are sensitive to a variety of human behaviors, then it is plausible to examine whether dogs are sensitive to and use various human facial cues in guiding their behavior. One of the first experiments to examine this question (e.g.,Virányi, Topál, Gácsi, Miklósi, & Csányi, 2004) examined whether dogs are sensitive to a human's direction of eye gaze. In this experiment, dogs were given the opportunity to beg for food from two strangers who did not verbalize and were seated on opposite sides of a table. One stranger's head was oriented toward the dog and this stranger attempted to make eye contact with the dog whereas the second stranger turned his or her head away from the dog and did not establish eye contact with the dog. Not surprisingly, results showed that dogs preferred (i.e., approached) the person whose head and eye gaze was directed toward the dog (Virányi et al., 2004). Thus dogs are able to discriminate a human's visual attention and prefer the person who is looking toward them.

If, as described above, dog's sensitivity to human facial cues influences their avoidance or approach toward an unfamiliar person, one might logically examine whether dogs reliably follow an unfamiliar person's direction of eye gaze to locate a target object (i.e., piece of hidden food). Soproni, Miklósi, Topál, and Csányi (2001) examined this question by using four conditions (pointing; turning the head and gazing at the target; turning the head and gazing *above* the target, and without moving the head – eye's only to the target) to determine whether dogs use a human's direction of eye gaze in a two-alternative food choice task. Results demonstrated that dogs reliably located the hidden food at a rate greater than chance when the experimenter pointed or looked using both head and eye-gaze. When the experimenter looked in the general direction – but not at the baited bowl, or the experimenter just shifted their eye-gaze while leaving their head oriented toward the dog, dogs' frequency of selecting the correct bowl did not exceed chance (Soproni et al., 2001). These results demonstrate that dogs are sensitive to and use an unfamiliar adult's head and eye gaze in locating a hidden piece of food but do not reliably use eye-gaze alone. Possible reasons for why dogs failed to use the eye-gaze alone could be that the head orientation and direction of eye-gaze were in conflict or perhaps, changing the direction of eye-gaze alone represent too subtle of a communicative gesture.

Based on the results of Soproni et al. (2001) future research is needed that examines canine exploratory behavior when a human's cues are put into conflict, e.g., head oriented toward the dog while their eyes are directed toward a baited bowl. While research has not examined canine performance within the context of conflicting cues, Szetei, Miklósi, Topál, and Csányi (2003) did examine whether dogs would rely on their own olfactory cues or a human's visual cues in selecting where to look for food. The authors found, logically, if the dogs had direct knowledge (visual or olfactory) of the location of the food, they would correctly locate it. When dogs were presented with contradictory cues, (a human pointing to the empty bowl instead of the baited bowl), dogs followed the human pointing gesture and ignored the available olfactory information that correctly specified the food was in another bowl (Szetei et al., 2003). In other words, dogs reliably used a human's pointing gesture to approach an un-baited bowl and ignored any olfactory cues that specified the foods location thus further demonstrating the fact that canines are highly sensitive to and use human's pointing and facial cues in guiding their behavior.

Affective Communication: Social Referencing

It is clear that humans are communicative from birth. Specifically the first information that is shared between adult and newborn is affective in nature (Gibson & Pick, 2003). Similarly, Fridlund (1994) points out that infants' facial expressions of affect are not simply a response to emotional stimuli, but are meant as communicative signals. Given that emotions are ubiquitous to humans and perhaps represent the first form of adult-infant communication, it seems logical that dogs too might respond to human emotional cues, especially in light of the length of time during which humans and canines have co-existed.

The use of emotional expressions as referential guides to unfamiliar stimuli defines social referencing.

Sorce, Emde, Campos, and Klinnert (1985) for instance, defined social referencing as “the observation of emotional states that inform another being in the presence of neutral stimulus”. In one of the earliest and most frequently cited studies to examine social referencing, Sorce et al. (1985) introduced 1-year-old infants to an apparent visual cliff. After placing the infant on the shallow side – facing a moderate drop-off - mothers of the infants placed a toy on the far side of the cliff and used emotional expressions (i.e., facial and verbal cues) to encourage their infants toward the visual cliff. Infants whose mothers posed a fearful expression did not crawl across the cliff, whereas those infants whose mothers posed a positive/happy expression readily crawled across the cliff. Finally, infants of mothers who posed an angry expression were somewhat mixed in their willingness/frequency of crawling across the cliff. This study, and countless others, have repeatedly shown that around 1-year of age, infants use another person’s communicated affective expression in guiding their own behavior (see Saarni, Campos, Camras, & Witherington, 2007 for a recent review).

Affective Cues

Because expressions of affect are ubiquitous communicative acts from a human’s birth and continue throughout the life span, and canines are sensitive to a variety of human communicative behaviors, it seems logical to examine whether canines are sensitive to humans’ communicative expressions of affect and whether affective expressions similarly influence canines’ exploratory behavior. As reviewed above, much work has been conducted examining whether canines are sensitive to various human behaviors. However, little research, to date, has examined whether canines are sensitive to a human’s communicated affective expression. One recent study, for example, examined whether canines respond to human affective cues (Merola, Prato-Previde, & Marshall-Pescini, 2012). These researchers examined whether dogs referentially looked to their owner when initially presented with a moderately fear inducing stimulus (a small oscillating fan with attached streamers). During the test trial when the owner communicated a positive or negative affective facial-vocal expression toward the fan, dogs exposed to the negative affect showed reduced rates of locomotion (i.e., behavioral freezing). When the owner approached and touched the fan, in the positive affective condition or retreated from and turned away from the fan in the negative affective condition dogs tended to stay near the owner. In other words canines tended to mirror the location of their owner without regard to the owner's affective expression toward the ambiguous object. In other words, while dogs alternated their gaze between the fan and their owner, it is still somewhat ambiguous as to whether the dogs approached/avoided the fan in response to their owner's affective behavior or whether dogs behaved in a manner to maintain proximity to their owner (Merola et al., 2012). These results indicate that when confronted with a novel stimulus, the dogs sought referential information, however, it is not clear whether it affected their exploratory behavior. In addition, and as noted by Merola et al. (2012) it is possible that the ambiguous object was not in fact ambiguous as pilot testing revealed that some dogs were quite fearful of the object. In addition, while Merola et al. (2012) reported that owners reliably communicated either a positive or negative affective expression it remains possible that other subtle differences between the owners may have affected their canine's behavior.

A more recent experiment examined whether communicated affect influenced canines' choice of a baited or non-baited bowl (Buttelmann & Tomasello, 2013). In this experiment a happy facial and vocal expression was paired with one box containing a food treat and a neutral facial and vocal expression paired with the other box containing sawdust. In the happy-disgust condition, they paired a happy facial and vocal expression with one box containing a food treat and displayed a disgusted look after they peered into another box containing garlic. Results showed the dogs performed at chance level in the happy-neutral condition, but tested above chance in the happy-disgust condition. In the happy-disgust condition it is difficult to judge whether canines approached one bowl because it was paired with the positive affect or if they approached it because they avoided the bowl with the negative affect. In addition, it is possible the difference in odor between garlic and a dog treat was enough to motivate the dog to choose the positive affective condition over the negative affective condition.

Current Experiment

Research has provided substantial evidence that dogs are sensitive to human communicative cues - especially human pointing cues. More recent research has shown that dogs *may* be able to use a human's affective facial and vocal cues (Buttelmann & Tomasello, 2013). The purpose of this study is to further explore whether an adult human's affective cues, when paired with a pointing gesture, influence canines exploratory or food search behavior. In this experiment, canines were provided a two-alternative food choice task similar to those in other studies (Hare, Brown, Williamson, & Tomasello, 2002; Soproni, Miklósi, Topál, & Csányi, 2002). In the current experiment, and similar to other studies, bits of food were used rather than a novel object to examine canine referential following. While studies of social referencing, by definition, use novel and ambiguous objects, it also possible that by using such objects, canines would not be motivated to explore them in any context.

In the current experiment an experimenter looked and pointed toward one of two bowls. What differed across conditions is whether the experimenter looked and pointed silently, or conveyed a positive or a negative affect while looking and pointing toward one of the bowls, and whether the referenced bowl was baited or sham baited (i.e., 1 silent baited; 2 positive baited; 3 negative non-baited; and 4 negative baited). In the silent baited condition (cond. 1) the experimenter looked and pointed silently toward the baited bowl. In the look, point, and positive affect condition (cond. 2) the experimenter looked and pointed while conveying a positive affect toward the baited bowl. In the look, point, and negative affect condition (cond. 3) the experimenter looked and pointed while conveying a negative affect toward the *non-baited* bowl. Within the first two conditions (look and point silently and look and point with a positive affect) it was predicted that canines would more frequently approach the referenced and baited bowl than the sham baited and non-referenced bowl. In condition 3 (look and point with a negative affect toward a non-baited bowl) it was predicted that canines would avoid the referenced and non-baited, or sham baited, bowl and would more frequently approach the non-referenced but baited bowl. It was also predicted that canines would more frequently approach the baited bowl when the experimenter looked, pointed and conveyed a positive affect than when the experimenter looked and pointed silently with no communicated positive affect.

A fourth condition was also included. In this condition (cond. 4) the experimenter looked and pointed while conveying a negative affect toward a *baited* bowl. This fourth condition was included to examine the possibility that canines in condition 3 (look, point, with a negative expression toward a *non-baited* bowl) might avoid approaching the baited and non-referenced bowl because A) the overall negative affect of the experimenter (i.e., induced fear) reduced the dog's overall level of exploration, or B) because the dog failed to receive a reward because it followed the experimenter's communicative gesture toward the non-baited bowl. Thus, in condition 4 the experimenter looked, pointed, and conveyed a negative affective expression toward the baited bowl. If canines' performance decreased in both condition 3 (look and point with a negative expression toward *non-baited* bowl) and condition 4 (look and point with a negative expression toward a *baited* bowl) this would suggest that the negative affect influences (i.e., decreases) canines overall exploratory behavior. If, however, canines' successfully approached the baited bowl in condition 4, but not condition 3, this would suggest that dogs' behavior is more affected by following pointing behaviors and being rewarded than by communicated affect.

Method

Participants

Eighty-seven domestic dogs (*Canis familiaris*) of various breeds were recruited from dog owners in Utah County, Utah. Of the 87 dogs, 27 dogs were excluded from our study (10 were too distracted, 9 refused to select either bowl, 5 were below 1 year of age and 3 displayed a side bias). The remaining 60 dogs were between 1- and 11- years (M = 5.4 years SD = 2.5 years). Twenty-nine dogs were male. A variety of breeds were recruited as prior research has failed to show reliable differences using similar tasks/procedures due to breed or age (Dorey, Udell, & Wynne, 2009). Table 1 lists the characteristics of each participant in terms of age, breed, gender, and whether the dogs had received obedience/agility training. All dogs lived with their owners and were considered pets. Dog owners were recruited via personal contacts and from fliers placed at businesses that provided for animal needs. Permission was obtained from owners prior to testing. Dogs were randomly assigned to one of four conditions.

Table 1: Participant Demographics by Condition, Name, Age, Gender And Breed

Condition 1: Silent Point Toward Baited Bowl

	Name	Age (Years)	Gender	Breed
1	Kyra	3.5	F	Husky
2	Ginger	8	F	Lab
3	Tulla	10	F	Collie
4	Mina	4	F	Pit bull
5	Sam	6	M	Malamute
6	Toaster	5	F	Lab
7	Samba	6	F	Rottweiler
8	Scout	5	M	Lab
9	Bode	11	M	Yellow Lab
10	Deegan	2	M	Pit bull/hound
11	Dozer	2	M	Pit bull mix
12	Mojo	4.5	M	Border Collie
13	Kayla	5	F	Pit bull/Boxer
14	Chipper	2	M	Lab
15	Nebo	4	M	Bernese Mt. dog
		M =5.2	Females = 7 Males = 8	

Condition 3: Negative Point Toward Empty Bowl

	Name	Age (Years)	Gender	Breed
1	Sydney	2	F	Lab Mix
2	Roan	4	M	German Shepherd
3	Hansel	9	M	Lab
4	Sydney	7	F	Thai Ridgeback/Pit-bull
5	Toby	5	M	Australian Kelpie
6	Henry	4	M	Lab
7	Sambo	1	F	Black Lab/Retriever
8	Scout	6	F	Golden Retriever
9	Titus	4.5	M	Lab/Husky mix
10	Brutis	5	M	Boxer English Bulldog
11	Jack	6	M	J. Russell Terrier/Yorkie
12	Puppy	8	F	Husky/Collie/Lab mix
13	Tank	7	M	Pomeranian/Schnauzer
14	Tennessee	7	F	Australian Shepherd
		M =5.4	Females = 6, Males = 8	

Condition 2: Positive Point Toward Baited Bowl

	Name	Age (Years)	Gender	Breed
1	Knysna	5	M	St. Bernard
2	Lucy	10	F	Black Lab
3	Lani	6	F	Golden Retriever
4	Oberon	2	M	German Shepherd
5	Buddy	3	M	G. Retriever/Lab
6	Chelito	7	M	Golden Retriever
7	Charly	4	F	Yellow Lab
8	Rosy	1	F	Golden Retriever
9	Pup	7	M	Shepherd/Rottweiler
10	Markus	10	M	Hound/Pointer
11	Tink	4	F	Cattle Dog Mix
12	Star	6	F	Pointer
13	Brooklyn	7	F	Austr. Sh./B. Collie
14	Chloe	3	F	E. Springer Spaniel
15	Mindy	4	F	Beagle/Greyhound
16	Hendrix	1	F	English Bulldog
		M = 5.0	Females = 10, Males = 6	

Condition 4: Negative Point Toward Baited Bowl

	Name	Age (Years)	Gender	Breed
1	Hansel	9	M	Lab mix
2	Lucy	7	F	Lab
3	Luca	5.5	M	Doberman
4	Scout	6	F	Golden Retriever
5	Jack	9.5	M	Yellow Lab
6	Tennessee	7	F	Australian Shepherd
7	Titus	5.5	M	Husky/Lab
8	Charley	4	M	Yellow Lab
9	Murphy	6	F	Border Collie Mix
10	Kenny	2.5	M	B. Collie/G. Pyrenees
11	Lucky	2	M	Shetland Sheepdog
12	Rumy	6	M	Boxer
13	Chance	7	M	Standard Poodle
14	Star	6	F	Clue tick/ coonhound
15	Buddy	6	M	Golden Lab
		M = 5.9	Females = 5, Males = 10	

Stimuli & Apparatus

The study was conducted in the former BYU equestrian barn (currently used as a storage building). Animal odors were not a concern as no large animals had been housed there for approximately 10 years. The trials took place during the winter semester and spring and summer terms of 2013 and occurred within a 12' x 13' enclosure that was surrounded by a 6' high opaque partition. Two stainless steel food containers, approximately 10cm in diameter and 6-8cm deep, were also used. The owners were given a choice of 2-3 possible dog treats that were used in baiting and scent marking the sham-baited bowl. Owners were asked to select the treat they believed to be the most rewarding or palatable for their dog from a variety of commonly available dog treats. The target dish was baited with a 1oz. dog-treat for each trial. Each session was video-recorded using a Canon Vixia HF R21 HD video camera and recorded events were used in subsequent coding

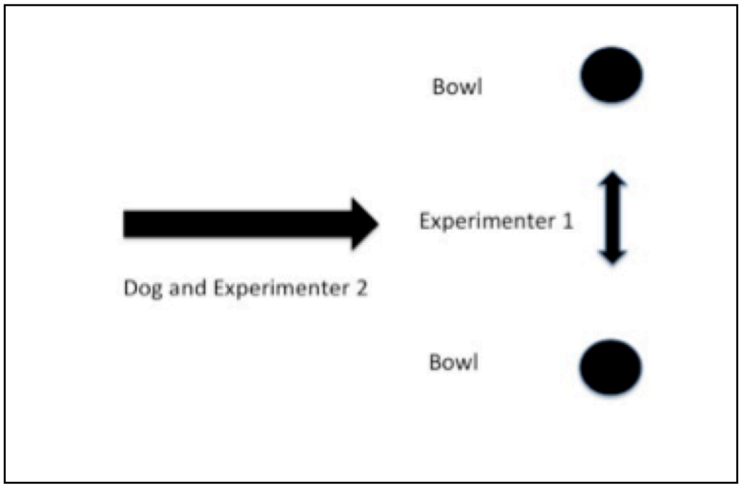
Procedure

A two-alternative food choice task was used to test dogs' ability to follow human communicative behaviors (e.g., Gácsi, Kara, Belenyi, Topal, & Miklosi, 2009). In the current experiment each dog participated in four warm-up trials and 12 experimental trials. To increase the likelihood that the dogs were motivated to perform the food choice task, only those dogs that had not eaten within the past four-hours and "passed" all four warm-up trials were included.

Warm-up Trials

Prior to the beginning of the warm up trials, each bowl was scent marked with the preferred food treat, in order to preclude the dog's use of olfactory cues in their choice of a bowl. Each dog was seated approximately 48" equidistant from the two bowls and the bowls were placed 36" apart. Experimenter 1 sat on a stool, centered equidistance between the two bowls and provided the various cues. Figure 1 below depicts the spatial layout of the testing area. Each bowl was placed 12" from Experimenter 1.

Figure 1.



Experimental set-up showing the location of experimenter 1 (the cuer), the dog, experimenter 2 (holding the dog), and the location of the two food bowls.

For each warm-up trial a second experimenter (E2) held the dog by the collar and E1 placed a 1oz portion of a treat into one bowl in full view of the dog and both experimenters. The other bowl remained empty and was not sham baited during the warm-up trials. Following baiting, E1 silently looked and pointed toward the baited bowl using their arm and index finger nearest to the baited bowl (not more than 24'' from the baited bowl) and gestured toward the bowl for 5 seconds. Immediately after E1 stopped the gesture E2 released the dog allowing it to explore the testing area. The procedure was repeated for the bowl on the opposite side with the opposite arm. After successfully completing two trials (i.e., finding the baited bowl) with uncovered bowls, E1 baited one bowl and covered each bowl with a large sheet of paper, as the dog and both experimenters observed which bowl was baited while both bowls were covered. If the dog failed to initially approach the baited bowl within 20s, the trial was ended and another warm-up trial commenced. Warm-up trials continued until each participant successfully passed a total of four warm-up trials (two with the bowls covered and two uncovered). Prior research using a similar warm-up procedure (Buttelmann & Tomasello, 2013; McKinley & Sambrook, 2000; Riedel, Buttelmann, Call, & Tomasello, 2006) has revealed that dogs typically need between 5-6 trials to reach 4 consecutively correct warm-up trials. In the current experiment if a dog failed 5 or more warm-up trials the data from the dog was excluded. No dog failed to meet this exclusion criterion. The purpose of the warm-up trials was to increase the likelihood that the dog 1) was aware that food would be placed in the covered containers and 2) would follow/use a human's pointing gesture. After the warm-up trials each dog was given a 1-2 minute break to further explore the area and interact with the owner or experimenter. If the dog showed signs of separation anxiety from the owner (inattentiveness or attempts to exit the test area in search of owner) during the warm-up trials the owner was invited to sit next to E2 during the test phase. The owners were cautioned against interacting with their dogs during the trials. Following the 1-2 minute break the experimental session began.

Experimental Phase

The purpose of this experiment was to examine how an unfamiliar adult's communicated affective behavior, as conveyed in the adult's face and voice, affects dogs' frequency of following a pointing gesture toward a baited bowl. The experimental phase consisted of four between-subjects conditions. Within each condition, each participant received a total of twelve 20s trials. The lateral positioning of the baited bowl was counterbalanced into one of two random orders within each condition and across participants.

Condition 1: Silent Baited. In this condition, like the warm-up trials, each dog was seated and held by a second experimenter 48" from the first experimenter and the two bowls. After the dog was positioned and seated a third experimenter (E3) baited and covered one bowl and sham baited and covered the second bowl. The order of baiting and sham baiting was counterbalanced across trials for each dog where on half the trials baiting occurred first and on the other half sham baiting occurred first. The first experimenter, but not the second experimenter or the dog, could observe which bowl was baited and which bowl was sham baited by E3. After the E3 had baited and sham baited and covered the bowls and left the testing enclosure, E1 began each trial. The trial commenced when the first experimenter (E1) called the dog's name and gained eye contact with the dog and began to alternate his or her gaze between the dog and point toward the baited bowl. In Condition 1 the experimenter did not give an affective cue or reference the sham-baited bowl. After the experimenter had looked and pointed toward the baited bowl and alternated his or her gaze between the bowl and the dog for 10s the experimenter then looked in his or her lap and the second experimenter then released the dog. Each dog was given 20s to approach/touch a bowl with its paw or snout. If the dog selected the baited bowl it was allowed to eat the treat. If the dog selected the sham baited bowl it was not provided with any treat or reward. After the dog had made its choice and/or eaten the treat the second experimenter retrieved and repositioned the dog and the next trial was commenced. This same procedure continued for the remaining 11 trials.

Condition 2: Positive Baited. Condition 2 is identical to Condition 1 in all respects with the exception that E1 conveyed a positive facial and vocal expression while looking and pointing toward the baited bowl. Within condition 2 the experimenter repeated the word "positive" in a positive or happy tone while alternating their focus of attention between the baited food bowl and the dog. Critically, the experimenter providing the pointing and affective gesture directed the communicative and affective behavior toward the baited bowl and not toward the dog.

Condition 3:Negative non-Baited. Condition 3 is identical to Condition 2 in all respects with the exception that E1 used a negative affective facial and vocal expression while repeating the word, "negative" and pointing toward the non-baited bowl.

Condition 4: Negative Baited. Condition 4 was different from other conditions because in this condition we wanted to examine whether dogs' behavior is more affected by following pointing behaviors and being rewarded than by communicated affect. Specifically, we wanted to know whether dogs would continue to follow a pointing gesture paired with a negative affective expression toward a bowl *containing* a treat/reward. In other words, in this condition the question we asked is whether the dog follows the "gesture" i.e., point paired with a negative affect because it receives a reward (i.e., condition 4) or whether the presence of a negative affect reduces canines overall level of exploration (conditions 3 and 4). This condition was identical in all respects to condition 3 (look, point, with a negative affective expression) except the experimenter referenced the baited bowl.

The order of communicating toward the baited or sham baited bowl was counterbalanced across all twelve trials. After completing all trials the owners were thanked and offered a package of dog-treats for their dog's participation.

Coding and Analyses

Each dog's bowl choices were scored live during the experiment by the second experimenter (i.e., the one who initially held the dog) and again from the videotapes by naïve undergraduates. Each dog was given a total of 20s per trial to choose a dish. A correct response (scored as 1) in Condition 1 (silent baited bowl) was defined as approaching/selecting the bowl referenced by the experimenter's neutral and silent expression and point. An incorrect response was scored as a zero and was defined as selecting/approaching the sham baited bowl. Correct and incorrect responses in Condition 2 (positive pointing) were coded identical to Condition 1. In Condition 3 (negative non-baited bowl) a correct response was defined as selecting the baited but non-referenced bowl (i.e., avoiding the sham baited-bowl paired with the experimenter's prohibition). An incorrect response in Condition 3 was defined as choosing the sham-baited bowl (i.e., the bowl paired with the experimenter's negative affective expression and point). In Condition 4 (negative baited bowl) we recorded whether the dog approached the referenced bowl (i.e., baited bowl) that was paired with negative affective facial and vocal expression and point or whether the dog approached the non-indicated and sham-baited bowl. A correct response in condition 4 was defined as choosing the referenced and baited bowl. An incorrect response in condition 4 was defined as choosing the non-indicated and sham-baited bowl.

In all conditions if a dog did not choose a bowl within 20s, that trial was coded as a non-choice (and was scored as a zero). We also coded, from the videotapes, the experimenter's behavior to assess whether the experimenter looked toward the correct bowl, provided the appropriate attention directing gesture, and critically examined/coded the quality of experimenter's communicative behavior. Moreover, we also assessed whether there were any systematic differences in the behavior of the dogs by experimenter.

Results

The dependent variable was the number of times dogs approached the appropriate bowl within each condition. For each trial a correct response was scored as a one, incorrect and no-response were scored as a zero. Data were initially subjected to a 2 (trial order) x 4 (experimenter 1) analysis-of-variance (ANOVA). In this initial analysis the between subjects factors were trial order and experimenter and the dependent variable was the frequency of selecting the correct or appropriate bowl. Results of this initial analysis failed to reach significance for trial order, experimenter, or any interactions (*all ps* $>.1$). I also examined whether there were any effects of sex of experimenter (i.e., whether the person providing the looking and pointing and affective gesture was male or female). The results of this analysis also failed to reach significance ($p >.1$). All subsequent analyses were collapsed across experimenter, experimenter gender, and trial order.

Two additional preliminary analyses were also performed. The first examined whether there is a significant effect of age. Canine ages were categorized into 4 groups (i.e, 0-3.0 years, 3.1-6.0 years, 6.1-9.0 years and older than 9.1 years). The results of a one-way ANOVA with age as the between subjects factor and frequency of selecting the correct bowl as the dependent variable failed to reach significance ($p > .1$). Thus canines' performance did not differ based on age.

I also examined whether there was an effect of breed or trial block on correct bowl selection. Examining trial block (trials 1-6 and 7-12) is important in order to assess learning. Specifically, I examined whether some dogs, or breeds, perform better on later trials compared to earlier trials as a result of practice or experience. In addition, it is also possible that dogs categorized as working breeds may reliably differ from non-working breeds in their proclivity for following a human's pointing gesture (Table 1 presents the breed age and sex data for each dog per condition). In order to examine the effects of breed on point following behavior, dogs were classified based on owner reports, into one of 7 categories (herding, sport, working, hound, terrier, nonsporting and toy) as described by the American Kennel Club (see Dorey et al., 2009, for a review). A 7 (breed) x 2 (trial block; trials 1-6 and trials 7-12) ANOVA failed to reveal a significant effect of breed, trial block, or breed by trial block interaction (all $ps > .1$). Thus I failed to observe any effect of breed, earlier or later trials, or interactions on canines' frequency of following an unfamiliar adult's communicative gesture.

The primary analysis examined whether the experimental condition affected canines' frequency of selecting the correct bowl/target. In this analysis a 2 x 4 ANOVA was conducted with gender of the dog (female and male) and condition (look and point silent, look and point positive, look and point negative non-baited, and look and point negative baited) as the between subjects factors and frequency of selecting the correct bowl as the dependent variable. The results revealed a main effect of gender, F (1, 52) = 6.7, p = .013, with female dogs (M = 8.93, S = 3.81) choosing the correct bowl at a significantly greater frequency than male dogs (M = 7.34, S = 3.34) across all conditions. The main effect of condition also reached significance, F (3, 52) = 49.8, p = .001. Post hoc comparisons (Tukey HSD[1]) revealed a significant difference between the negative non-baited condition (condition 3) and the other three conditions (silent baited, positive baited, and negative baited). Conditions 1, 2, and 4 did not reliably differ. The means for each condition are as follows and can seen below in Figure 2.

Figure 2.

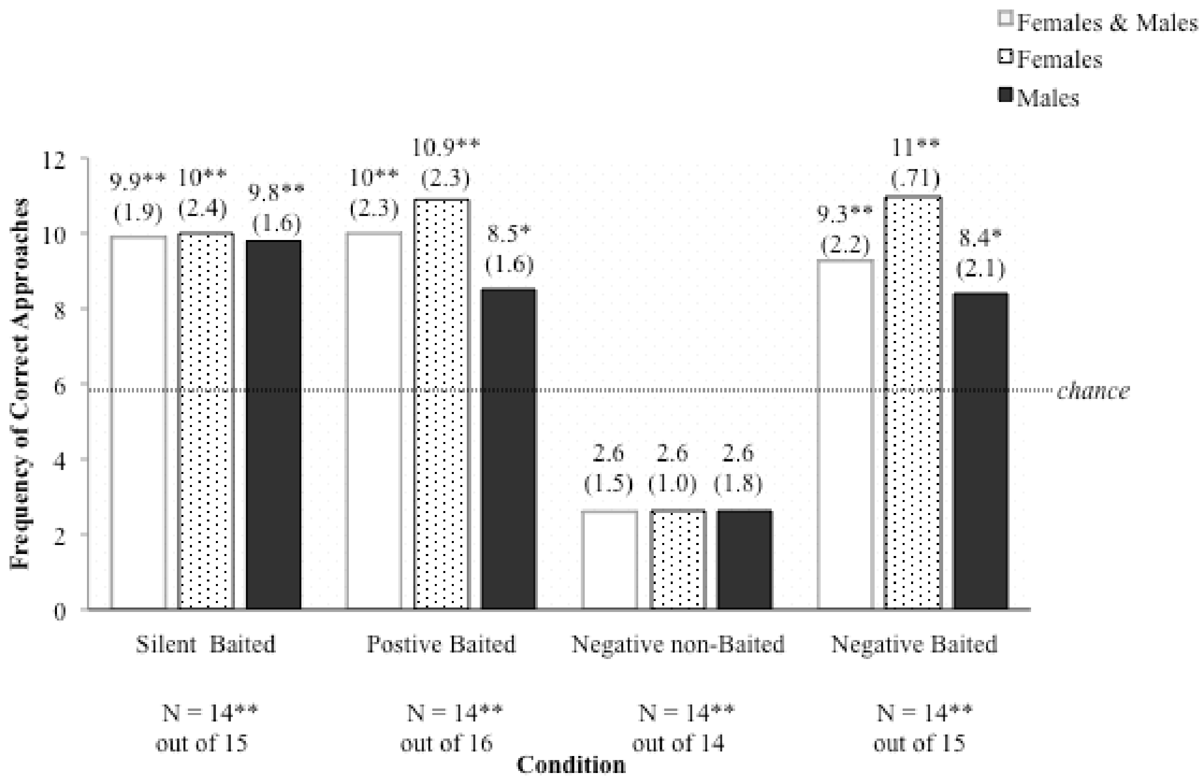


Figure 2. Mean (SD) frequency of selecting the correct bowl for each condition. The dashed line represents the frequency of selecting the correct bowl that would occur by chance (50%) alone. N = the number of dogs by condition whose frequency of selecting the baited bowl exceed chance (i.e., 50% or 6 out of twelve trials) using a two-tailed binomial.
** p <.01
* p < .05

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[1] A Bonferroni post-hoc comparison was also selected and the results did not differ from those of the Tukey HSD.

The mean number of correct responses in condition 1 (silent look and point baited) was *M* = 9.9, *SD* = 1.9. For condition 2 (positive look and point baited) the mean number of correct responses was *M* = 10.0, *SD* = 2.3. For condition 3 (negative look and point non-baited) the mean number of correct responses was *M* = 2.6, *SD* = 1.5, and finally within condition 4 (negative look and point baited) the mean number of correct responses was *M* = 9.3, *SD* = 2.2. The interaction between gender and condition failed to reach significance, F (3, 52) = 1.9, $p > .1$.

While dogs reliably followed cues in the look and point, silent baited condition (cond. 1) and the look and point, positive baited condition (cond. 2), the difference between these two conditions did not reach significance ($p > .1$). Thus the addition of a positive affective facial expression and vocalization did not increase canines' frequency of selecting the correct bowl from looking and pointing alone. Similarly, canines' frequency of selecting the correct bowl when the experimenter looked, pointed and conveyed a negative affective expression toward the baited bowl (cond. 4) did not reliably differ from looking and pointing silently (cond. 1) or looking and pointing with a positive affect (cond. 2). In other words canines' frequency of selecting the correct bowl/location did not reliably differ when the experimenter only looked and pointed or when the experimenter looked, pointed, and conveyed a positive *or* negative affective expression toward a baited bowl (all $ps > .1$). However, canines' frequency of selecting the correct bowl was reliably less when the experimenter looked, pointed, and conveyed a negative affective expression toward the *non-baited* bowl (cond. 3) compared to all other conditions ($p < .01$). Thus, and only in condition 3, dogs did not reliably select the baited bowl when the experimenter looked, pointed, and conveyed a negative affective expression toward the *non-baited* bowl. Taken together, it seems dogs disregarded the affective valence of the experimenter and chose the bowl that is referenced when it is baited (cond. 1, 2, & 4) and did not follow the experimenter's gesture toward a non-baited bowl when the experimenter conveyed a negative affective expression (cond. 3).

A two-tailed binomial test was also performed to examine whether the number of correct choices per condition exceeded chance (see Figure 2). Results showed that dogs frequency of selecting the correct bowl in all baited conditions (look and point silent; look and point positive; look and point negative) exceed chance (all p values < .01). Dogs' frequency of selecting the *incorrect* bowl in the look, point, negative affective and non-baited condition (cond. 3) exceed chance ($p <.01$). In other words, in condition 3, all 14 of the 14 dogs tested reliably choose either the wrong bowl (i.e., followed the experimenter's point to the empty and prohibited bowl, n = 8) or made no decision (n =6). The results of the two-tailed binomial are convergent with the results of those of the ANOVA examining canines' frequency of cue following by condition.

Discussion

The purpose of this study was to explore the effects of human affective cues on canine cue following (i.e., exploratory) behavior. Results of condition 1 (look and point silent) revealed a replication of previous research showing that canines reliably follow a human's pointing gesture (Hare & Tomasello, 1999; Á Miklósi et al., 1998; Ádam Miklósi & Soproni, 2006; Soproni et al., 2001). The results of condition 2 (look and point with a positive expression) similarly revealed that canines reliably followed adults' pointing gestures but not more frequently than when the experimenter looked and pointed in silence. The results of condition 3 (look and point with a negative affective expression) revealed that dogs *did not* reliably follow the experimenter's pointing gesture toward the referenced but prohibited and non-baited bowl. Rather dogs tended to avoid both bowls within condition 3. Finally, and not surprisingly, in condition 4 (look and point with a negative expression) results revealed that dogs continued to follow the experimenter's gesture toward the pointed/referenced bowl even when the experimenter conveyed a negative facial and vocal expression. Additionally, the age and the breed of the dog did not reliably affect their frequency of following the experimenter's gestures. Taken together these results suggest that affective communication does not have a significant effect on canines' point following behavior. Rather it seems dogs reliably follow an adult's pointing gesture even when the gesture indicates, based on the experimenter's negative affective tone (condition 4), to not approach a particular location – but only when the bowl is baited. Finally, and to my knowledge, this study is the first to directly assess how affect, when paired with a pointing gesture, influences canines' exploratory behavior.

While the results failed to show that the addition of an adult's positive affective facial and vocal expression increased canines' point following behavior, the results are similar to those of Pettersson, Kaminski, Herrmann, and Tomasello (2011). In their study, the experimenter established either cooperative or a competitive interaction with the dogs prior to examining their proclivity for point following. Results revealed that canines reliably followed the human's pointing gesture toward the correct location following a cooperative interaction and they failed to follow, i.e., were inhibited, in approaching either bowl following a competitive interaction and a "stop" gesture. The results of the current study are similar to the results of Pettersson et al. (2011) because the adult's positive affective behavior, paired with a point, was associated with canines' point following behavior. Likewise, when the experimenter presented a negative affective communicative signal, canines often hesitated, wandered around longer, but often selected the bowl paired with the negative affect and point – but only when that bowl was baited. The current study went beyond Pettersson et al. (2011) as our results indicated that the addition of a positive affective expression did not lead to increased point following behavior beyond a neutral and silent looking and pointing gesture where Pettersson et al. (2011) did not include a silent pointing condition.

While it's unclear why positive affect did not differ significantly from silent pointing, it is possible that canines had difficulty perceiving the difference between positive and neutral facial and vocal affect and relied heavily on pointing cues. Finally, it should be noted that in this study the average number of correct responses in condition 1 (silent) was 9.9 and in condition 2 (positive with pointing) the number of correct responses was10 out of 12 trials, which suggests there may have been a ceiling effect in these two conditions that may have precluded finding a statistical difference between the two conditions.

The results of condition 3 (negative with pointing toward an empty and non-baited bowl) are interesting in that dogs did not follow the adult's pointing gesture toward the empty but referenced bowl. While it was not predicted that dogs would follow the adult's pointing gesture to the pointed and prohibited and non-baited bowl, dogs also did not, and as predicted, approach the baited but non-referenced bowl. Within this third condition dogs were more hesitant to leave the first experimenter (the one holding the dog), they often explored the enclosure, or did not approach any bowl. Such a pattern of results suggests that dogs did not interpret the negative affective behavior as referential and may have experienced a type of mood or affect reduction. Another possibility is that dogs did not follow the point in condition 3 because they were not rewarded. The results of condition 4 (negative affect and pointing toward a baited bowl) are consistent with such an explanation as dogs within condition four did reliably follow the experimenter's pointing when paired with a negative affective expression – so long as it was directed toward a baited bowl.

Taken together these results further demonstrate that canines are adept at following a human's pointing gesture. In addition, the presence or absence of an affective cue does not seem to influence this behavior. However, the presence or absence of a reward does influence canines' frequency point following behavior and is consistent with prior research (e.g. Bentosela, Barrera, Jakovcevic, Elgier, and Mustaca (2008). For example, Bentosela et al. (2008) found that when dogs that were not rewarded for gazing at an experimenter's face there was a steady decline in gaze duration across trials. Thus it seems pointing has a greater influence on canine behavior, especially when combined with a reward, than affective behavior and is consistent with other studies that also fail to show that canines reliably use affective cues in guiding their exploratory behavior (Bentosela, et al., 2008; Buttelmann, & Tomasello, 2013; Pettersson, et al., 2011). Finally, one surprising finding was that female dogs were significantly more likely to follow cues than male dogs in two of the four conditions. As this finding has not been consistently found in other studies, future research should be conducted to replicate and explore this result.

There were a few weaknesses in this study. One potential methodological error concerned how we coded the dog's choices in the non-baited condition. In the three other conditions, we measured the number of times that dogs approached the baited bowl, which coincided with the pointing gesture. In the non-baited condition, we didn't measure the times the dog followed the point, instead we measured the times the dogs approached the non-indicated bowl. Since this thesis was based on how affect impacts canine point following, perhaps we should have continued to measure the number of times the dogs followed the point instead of the number of times they approached the non-indicated bowl. Future studies could measure the number of times that dogs followed the point rather than the baited bowl.

A final possible explanation for dog's reliance on points over affect may be attributed to the difference between the human and canine brain. The Triune Brain Model (MacLean, 1990) specifies that the human brain consists of the reptilian, the limbic and the neo-cortex. The neocortex is associated with higher-level cognitive functions, such as the ability to analyze and generalize communication cues. The neocortex of the canine brain is not as advanced as in the human brain. While canines have the ability to *feel* emotion, they may lack the brain structures necessary to analyze subtle emotional cues as easily as they perceive physical cues. As a result, their responses to referential signals are more reflexive than analytical. This may be why canines are more likely to respond to pointing than human emotion. Still such an explanation or hypothesis is beyond the scope of this thesis – but such a neuro-evolutionary question represents one avenue for future research.

In summary, while humans are adept at perceiving and utilizing affective and pointing cues (Vaillant-Molina & Bahrick, 2012), canines predominantly use pointing cues and do not appear to use affect in a referential manner and is consistent with prior research (e.g., Bentosela, et al., 2008; Buttelmann, & Tomasello, 2013; Pettersson, et al., 2011). This study was the first to examine and compare human pointing gestures with and without affective cues. This study contributes to the literature by suggesting that while humans use both physical pointing and affective cues referential cues, we found that canines reliably use physical cues but not affective cues. This is important because, while research has found that dogs are sensitive to certain kinds of social cues (human attention, body position, facial features), canines rely on physical signals rather than more subtle or non-ostensive cues. Finally, the fact remains that canines and humans have co-existed and evolved for more than 10,000 years thus the question what types of communicative behaviors and cues are shared, how this develops, and those factors that affect its development remain important for future research.

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