Accepted Manuscript

Title: Classifying Dogs' (*Canis familiaris*) Facial Expressions from Photographs

Authors: Tina Bloom, Harris Friedman

PII: S0376-6357(13)00032-6
DOI: http://dx.doi.org/doi:10.1016/j.beproc.2013.02.010
Reference: BEPROC 2604

To appear in: *Behavioural Processes*

Received date: 2-7-2012
Revised date: 6-1-2013
Accepted date: 18-2-2013

Please cite this article as: Bloom, T., Friedman, H., Classifying Dogs' (*Canis familiaris*) Facial Expressions from Photographs, *Behavioural Processes* (2013), http://dx.doi.org/10.1016/j.beproc.2013.02.010

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Highlights for Classifying Dog's (*Canis familiaris*) Facial Expressions from Photographs

by

Tina Bloom

Harris Friedman

Highlights

- A protocol to produce emotions in dogs was developed.
- Expert dog trainers were highly consistent in identifying emotions in dogs.
- People, in general, were able to identify emotions in dogs while people who were experienced with dogs were better at identifying behavioral situations than were inexperienced people.
- Experienced, but not expert, people made more errors in identifying aggression in dogs than did inexperienced people.
- Ekman's cross-cultural work on facial expression was extended to a non-primate species.

Keywords: Comparative Psychology; Dog; Emotions; Evolution; Facial Expression; Yawning

Accepted Manuscript

ACCEPTED MANUSCRIPT

Classifying Dogs' (*Canis familiaris*) Facial Expressions from Photographs[1]

by

Tina Bloom[a]

Harris Friedman[b]

Accepted Manuscript

[a] Pennsylvania Department of Corrections, State Correctional Institute: Forest, Psychology Department, 1 Woodland Drive, PO Box 307, Marienville, PA, 16239, USA. tibloom@pa.gov.

[b] Walden University, 1270 Tom Coker Road, LaBelle, FL 33935 FL, USA. harrisfriedman@hotmail.com.

[1] This paper is based on the first author's dissertation (Bloom, 2011) at Walden University, supervised by the second author (Friedman, whose primary appointment is at University of Florida). Additional details of the study can be found in the dissertation. Correspondence should be directed to the first author at tbloom@modernvillagedogs.org.

ACCEPTED MANUSCRIPT

Abstract

Humans accurately read other humans' emotional facial expressions. Little research was found examining human ability to read dogs' expressions. Cross-species research extended facial expression research to chimpanzees, and there is much research on dogs' auditory signaling to humans. To explore humans' ability to identify dogs' facial displays, photographs of a dog's face were taken under behaviorally defined conditions expected to elicit specific emotions. Dog experts consistently rated these photographs. The photographs rated as best by experts were used as stimuli for people experienced and inexperienced with dogs. Both groups were able to read the dog's emotions. Paradoxically, experienced people were less accurate reading aggressiveness. Experienced people were better identifying behaviorally defined situations. Research using behaviorally anchored, standardized photographs is recommended.

Accepted Manuscript

ACCEPTED MANUSCRIPT

1. Introduction

Bolwig (1964) described specific facial expressions that occur in various canines. He noted striking similarities between primates and domestic dogs in their facial expressions of happiness, sadness, fear, and anger while in social situations. However, Fox (1970) noted that due to dogs' domestication, they might be less reliable as study subjects. He chose wolves, coyotes, and foxes for his extensive research on facial expressions in canines. Thus, dogs have been virtually ignored as far as their social and emotional signaling, even though there is much evidence that they have a long history with humans (Davis & Valla, 1978; Groves, 1999; Nobis, 1979; Paxton, 1994 & 2011; Vila et al. 1997) and they uniquely benefit us in an emotional manner (Barker, 1999; Bracha, 2006; Bracha & Masser, 2009; Odendaal, 2000). Understanding dogs' communicative signaling could offer many benefits, for example, facilitating the coordination between dogs and the many kinds of people who utilize them such as law enforcement officers, military operators, therapists, handicapped individuals, and even pest control specialists.

There is no doubt that humans have the ability to recognize emotional states in other humans, which is greatly facilitated by observations of facial expressions (Dimberg, Thunberg, & Elmehed, 2000; Ekman, 1993, 1994, 1997, 1999, 2003; Ekman & Friesen, 1969, 1971, 1974, 1975, 1976, 1978; Ekman et al., 1987; Ekman & Oster, 1979; Ekman, Sorenson, & Friesen, 1969; Ruys & Stapel, 2008, Wilson & Knoblich, 2005). Human facial expressions appear to be governed by universal rules that can be coded into action units (AUs) utilizing the Facial Action Coding System (FACS, Ekman & Friesen, 1978; Ekman, Friesen, & Hager, 2002a & 2002b). Communication via facial expression as described by Ekman and his colleagues has rarely been

Accepted Manuscript

ACCEPTED MANUSCRIPT

examined across species. One recent example of such an examination utilized the Chimp Facial Action Coding System (ChimpFACS; Parr, Waller, & Heintz, 2008; Parr, Waller, Vick, & Bard, 2007). Although there are some notable differences between human and chimpanzee facial expressions (e.g., chimpanzees facial expressions rely more on ear and head movements), Parr and colleagues' work expands the research on facial expression to another primate species. Other than these few studies extending Ekman and colleagues work to primates, the decoding of facial expressions across species has been limited.

Conversely, auditory signaling as described by Morton (1977) has often been examined across species (Furrer & Manser, 2009; Isack & Reyer, 1989; McConnell, & Baylis, 1985; Pongracz, Molnar, & Miklosi, 2006; Pongracz, Molnar, Miklosi, & Csanyi, 2005; Seyfarth & Cheney, 1990; Shriner, 1998). Morton observed that auditory communication within and between species follows basic rules, for example, low-pitched growling noises indicate aggressiveness while high-pitched noises indicate placidity. Humans' ability to classify dogs' vocalizations has been found to use various combinations of tonality, peak-frequency, and inter-bark interval to identify different emotional states in dogs (Pongracz et al., 2006). Furthermore, Pongracz and colleagues concluded that humans' ability to recognize basic emotions assisted them in accurately categorizing canine acoustic signaling.

Parallel to acoustic signaling of dogs' emotional states, visual signaling of emotional states may follow basic rules. Darwin (1872/1998) described and illustrated detailed visual displays of emotions in several species, including dogs. Darwin claimed that all species express emotions, while more advanced species demonstrate more intricate emotions. He also asserted that humans could ascertain emotions in other animals via both their facial and body expressions, using illustrations of a dog and a cat to demonstrate this claim. We suspected that the decoding

Accepted Manuscript

ACCEPTED MANUSCRIPT

of visual signaling of emotions in dogs, via facial expression, may follow the rules Ekman and colleagues described for human-to-human communication of emotion.

Some humans claim to be able to read emotional facial expressions in dogs, whereas others are skeptical of such a human ability. Consequently, we investigated whether dogs' facial expressions can be identified accurately in photographs of a dog's face. In order to begin to examine our hypothesis that visual signaling of emotional states may follow rules such as those found in acoustic signaling and may correspond to AU's as described by Ekman and colleagues, we examined whether experts in dog behavior displayed significant concordance when ranking photographs of a dog's face taken under seven behaviorally defined conditions, which we inferred related to emotional states. Second, we examined whether non-experts could judge these expected emotional states of that canine and identify the conditions under which the photographs were taken. Third, we examined differences between humans who had significant experience with dogs and those who had little experience with dogs.

2. Materials and Method

2.1 Study 1: Expert Rankings

2.1.1 Participants. We used three expert judges, whose ratings were independent of one another: two males (ages 32 and 37) and one female (age 28). We defined experts as persons who trained at least one dog within the *Schutzhund* sport (in which dogs participate in tracking, obedience, and protection) from beginning to Schutzhund Three (SchH3, which is the sport's highest level of attainment), and who also had competed in at least one national championship with such a dog.

2.1.2 Canine Subject and His Photographs. We used one well-trained, five-year-old, male Belgian Malinois (named Mal) police dog to create the photographs under behaviorally

Accepted Manuscript

ACCEPTED MANUSCRIPT

controlled conditions. We chose a Belgian Malinois because of its wolf-like morphology, in accord with Fox's recommendation (1970), and we selected Mal because he was capable of obediently holding positions and could be photographed in situations evidencing his emotional reactions. We attempted to closely reproduce Ekman and Friesen's (1976) database of photographs of human faces expressing emotion by using methods similar to those used by Pongracz et al. (2005) when studying vocalizations in dogs. We also followed procedures used by Parr, Waller, Vick, and Bard (2007) when choosing photographs for their ChimpFACS project. Extraneous elements in the photographs that had the potential to cue participants about the circumstances in which the photographs were taken (e.g., the presence of Mal's toy in a happiness condition) were cropped from the photographs. This process resulted in 10 photographs for each of the seven conditions.

2.1.3 Apparatus and Materials. We used a Canon 1D Mark III Camera (with a 24-104L Lens and White Lightning XL1600 Flash) to take the photographs. We placed a curtain behind the dog to create a neutral background, such as that found in Ekman and Friesen's (1971, 1976, 1978) photographs. A professional photographer took the photographs, and we retained only high quality photographs for use in the remainder of the study.

2.1.4 Behaviorally Defined Conditions. We used emotion-producing stimuli to define the six basic emotions described by Ekman and Friesen (1976, 1978): happy, sad, surprise, disgust, anger, and fear. Additionally, we used a neutral condition as a standard for comparison. As used by Pongracz et al. (2005), we anchored emotional reactions in behaviorally defined situations, rather than to presume what Mal might be feeling. The following seven situations were used:

Accepted Manuscript

ACCEPTED MANUSCRIPT

Happy: Mal's handler told him to sit and stay. Then his handler told Mal, "Good boy. We are going to play soon." Mal had thousands of repetitions of these words meaning that his handler would pull a ball from his pocket and play with him. Once the picture was taken, Mal was released and given his ball as a reward.

Sad: Mal's handler told him to sit and stay. Mal's handler verbally expressed disappointment in Mal's performance by stating, "Pfui [pronounced "Fooey"], Mal, Pfui." The photographs had to be taken quickly in this condition, because often Mal attempted to move to another position (e.g., a down or a stand) when he was given this command, which to him meant that his current position, a sit, was incorrect.

Surprise: Mal's handler told Mal to sit and stay. While Mal was sitting, his owner held a jack-in-the-box that Mal has never seen before. As Mal watched his owner, the jack-in-the-box popped out unexpectedly. Several jack-in-the-boxes were used to maintain the element of surprise for Mal.

Disgust: Mal's handler told Mal to sit and stay. Mal was sitting and expecting a food reward from his owner. However, instead, his owner offered him a medication he is known to find distasteful.

Anger: Mal's handler told Mal to sit and stay. A "bad guy" from the sport of Schutzhund teased Mal, but not so much to allow Mal to take action, as per the rules of the sport (similar to the Pongracz et al, 2005, "Schutzhund" situation under which they recorded "aggressive" vocalizations in the Mudi, another breed of dog). These pictures were taken quickly because in the rules of the sport, at the time when the "bad guy moves

Accepted Manuscript

ACCEPTED MANUSCRIPT

enough," Mal could break his sit and apprehend him. Of course, the "bad guy" was wearing her standard Schutzhund protective clothing.

Fear: Mal's handler told Mal to sit and stay. A pair of dog toenail trimmers, which Mal feared, were held by his handler who told Mal, "We are going to do your nails," while making eye contact with Mal.

Neutral: This is not one of Ekman's seven basic emotions but, for comparison purposes, we took pictures of Mal when nothing had occurred for three minutes (while he had been sitting with his owner present). We selected this amount of time to designate being calm, defined as not being exposed to any significant emotional stimuli, as this is the length of time the American Kennel Club (AKC, 2008) requires a dog to sit and stay to earn its Companion Dog Excellent status.

2.1.5 Ranking of Photographs. Individually, each expert ranked the 10 photographs taken from each behaviorally defined condition from best to worst. We also recorded the qualitative comments made while sorting the photographs for quantitative analysis.

2.1.6 Data Analysis. We used Kendall's Coefficient of Concordance to determine agreement among the judges. Once the photographs were ranked, we selected the three photographs from each of the seven behaviorally defined conditions that were the best examples of the conditions to use as stimuli for the subsequent stages of the investigation. In accord with Pongracz et al.'s (2005) procedure for evaluating auditory stimuli, we chose three instances of each behaviorally defined situation, which resulted in a total of 21 photographs.

2.2 Study 2: Experienced versus Inexperienced Judgments

Accepted Manuscript

ACCEPTED MANUSCRIPT

2.2.1 Participants. Two groups of participants rated the 21 photographs for their emotional content. The first group consisted of 25 people (three males and 22 females, ages 24 – 68) judged to be experienced with dogs, but not experts. They were people who had trained at least one dog to an entry level (Companion Dog or CD) title in the American Kennel Club (AKC). Experienced people were found in various AKC dog training clubs where such people congregate to train their dogs. The second group of people consisted of 25 people (three males and 22 females, ages 28 - 70) who identified themselves as having minimum experience with dogs (i.e., they never owned a dog and they had experienced few interactions with dogs) . These inexperienced people were located in non-canine related organizations such as theater, musical, and literary groups.

2.2.2 Apparatus and Materials. The 21 photographs of the dog's expression most consistently categorized as the best photographs by the experts during the development phase of the study were used for stimuli in the remainder of the study. For the emotionality ratings, we presented a response sheet listing each basic emotion (i.e., Happy, Sad, Surprise, Disgusted, Angry, and Fearful) accompanied by a Likert-type scale (ranging from *0* indicating "None of this emotion present" to *4* indicating "As much of this emotion as possible is being displayed"). This is the same scaling procedure used by Pongracz et al. (2005). For the categorization of the behaviorally defined conditions, we used a response sheet describing the behavioral situation.

2.2.3 Rating of Emotions and Categorization of Situation. In the first task, we asked participants to individually rate each photograph from *0* to *4* for each of the six basic emotions after we told them that the photographs may have one emotion or mixed emotions. We told participants to report what emotions and to what degree, if any, they perceived as present, and

Accepted Manuscript

ACCEPTED MANUSCRIPT

that there were no right or wrong answers. Additionally, we recorded qualitative comments made about photographs as they were being rated.

Similarly in the second task, we gave each participant a list of the actual behavioral situations to which we exposed Mal when the photographs were taken. We then asked them to select the correct situation for each of the 21 photographs, given the situations described on the response sheet. Again, we recorded qualitative comments made about the photographs as they were being rated.

We used a Latin-square design to randomize the order of presentation for both emotionality rating and situation categorization. We allowed participants to examine the photographs until they responded. When participants asked questions during the emotional rating procedure, we told them, "Please, look at the rating scales you have and rate the emotions, if any, that you believe you see in the photograph that you are viewing." During the situation categorization procedure, we told them, "Please select the situation you believe the dog is experiencing in the photograph you are viewing." We placed the interviewer behind a screen, so the participants could not see the interviewer and the interviewer could not see the participants, as the participants made their ratings and categorizations.

2.2.4 Data Analysis. For the emotional rating task, each photograph had a rating on each emotional dimension. The independent variables were the two experience levels of the raters and the seven expected emotions anchored in the behavioral conditions during which the dog was photographed. The dependent variables were the emotionality ratings given by the participants as well as percent correct (with correct being defined as the identification of the expected emotion given the behavioral condition). By allowing the participants to rate the

Accepted Manuscript

ACCEPTED MANUSCRIPT

intensity of expression of each of the six basic emotions for each photograph, instead of giving them a forced choice of selected emotions, we believed we were improving our content validity. Due to the data's heterogeneity of variance and lack of normality, rank-order analyses such as that used by Pongracz et al. (2005) were performed to assess human's ability to identify emotionality expressed on dogs' faces. Additionally, expected emotions versus perceived emotions were presented in a 7x7 confusion matrix.

For the categorization of situation task, one-sample *t* tests were used to compare the accuracy of the participants from chance responding, as was done by Pongracz et al (2005). In this task, each group's accuracy was compared to chance expectations, while the dependent variable was assessed by percent correct. Because only two groups were used in this study, independent *t* tests were used to compare groups.

3. Results

Throughout this results section, we use the behavioral description (e.g., Bad Guy) in lieu of the emotion word (e.g., Angry) when discussing the condition the dog might have been experiencing, because we can only infer, but not verify, what emotions Mal might have experienced in the behaviorally defined situations. However, when discussing emotions (as in the emotion ratings), we stated the expected emotion, as well as the behavioral situation intended to create it, in the first sentence of the paragraph, while always anchoring the expected emotion to what we actually did to Mal. Then, we use the emotion word standing alone throughout the specific discussion of that particular condition. All photographs are labeled with their respective behavioral situations.

3.1 Study 1: Expert Rankings

[insert Figure 1 approximately here]

Accepted Manuscript

ACCEPTED MANUSCRIPT

When experts were asked to rank the 10 photographs from best to worst, agreement among the three judges was statistically significant in each of the seven conditions:

3-Minute sit (Neutral), $W = .995$, χ^2 (9, $N = 3$) = 26.86, $p < .001$;

Ball (Happy), $W = .957$, χ^2 (9, $N = 3$) = 25.84, $p < .002$;

Reprimand (Sad), $W = .981$, χ^2 (9, $N = 3$) = 26.49, $p < .002$;

Jack-in-the-box (Surprised), $W = .978$, χ^2 (9, $N = 3$) = 26.42, $p <$ 002;

Medicine (Disgust), $W = .968$, χ^2 (9, $N = 3$) = 26.13, $p < .002$;

Toenail trimmers (Fear), $W = .987$, χ^2 (9, $N = 3$) = 26.63, $p <.002$; and

Bad guy (Anger), $W = .973$, $\chi 2$ (9, $N = 3$) = 26.27, $p < .002$.

[insert Table 1 here]

Table 1 displays the mean ranks of the 10 photographs within each condition. We used the photographs ranked as first, second, and third best for depicting each condition as stimuli for the remainder of the study, and they are displayed in Figure 1.In addition to the quantitative data collected, we recorded qualitative comments made by the experts for their possible heuristic use. Often, the experts made similar comments during their ratings of the photographs.

For example, the experts noted that all the neutral condition (Three-Minute Sit) photographs appeared to display the emotion happy. Additionally, the Medicine (Disgust) condition was difficult to differentiate from other negative emotions, and that people without extensive experience and without knowledge of the situation may confuse this display as aggressive due to the "wrinkled nose," "showing of the teeth," or the "apparent snarling" (see Photograph Medicine 4). All of the experts noted that the Jack-in-the-Box (Surprised) condition

Accepted Manuscript

ACCEPTED MANUSCRIPT

photographs appeared to display more "curiosity" or "inquisitiveness" than surprise. All of the expert judges noted the Reprimand (Sad) condition displayed "submissiveness" that would be difficult to distinguish from other negative emotions (perhaps Fear) without knowledge of the situation. All three judges noted that the fear condition photographs could easily be confused with surprise. They all noted that that fear and surprise would be difficult to differentiate (for the Toenail Trimmer, or Fear, condition) without knowing the condition the dog was experiencing. Last for Study 1, in the Bad Guy (Anger) condition, all three experts believed the only pure anger (aggression without fear) photograph was Bad Guy Photo 8. However, all three experts believed that people without knowledge of dogs would confuse this photograph with a "happy" expression, thus it was rated in various positions (1, 2, & 3) by the three judges.

3.2 Study 2: Experienced versus Inexperienced Emotion Ratings.

[insert Figure 2 approximately here]

[insert Figure 3 approximately here]

All participants rated photographs in the Three-Minute Sit (Neutral, pooled over groups), $\chi 2$ (5) = 206.52, $p < .001$, and Ball (Happy, pooled over groups), χ^2 (5) = 195.10, $p < .001$, conditions as displaying happiness most strongly. When rating photographs in the Ball condition, the largest difference between the groups in ratings for this condition was on the Happy Rating Scale wherein Experienced Group's participants rated the dog's expression to be happier (Experienced $M_{(Happy)}$ = 3.05, SD = .87, Mean Rank = 31.02) than did the Inexperienced Group's participants (Inexperienced $M_{(Happy)}$ = 2. 40, SD = .88, Mean Rank = 19.98). Mann-Whitney tests indicated that this between groups difference was statistically significant, U

Accepted Manuscript

ACCEPTED MANUSCRIPT

(N=50) = 174.50, $p < .01$. No other differences were found between the groups in these two conditions. Both groups rated the dog's emotion in this condition to be predominantly happy.

[insert Table 2 Here]

When the rating scales were collapsed by comparing only correct versus incorrect identification of the expected emotion (i.e., by choosing the highest rated emotion as the emotion that the participant identified), data from both groups indicated that happiness was easily identifiable by all the human participants (Experienced 92%; Inexperienced 84%) while, when pooled over both groups, participants consistently identified happiness correctly for the Ball condition 88% of the time. Similarly, pooled data showed that the neutral condition was strongly evaluated as being happy. Table 2 displays the percentage of correct choices in all pooled conditions, displayed in a confusion matrix.

When examining between the two conditions (Ball and Three-Minute-Sit), neither group rated the Ball condition to be significantly happier than the Three-Minute-Sit condition. Wilcoxon Signed Rank for correlated groups was used post hoc to examine the difference between the Happiness Rating Scales for each group across the two different behaviorally defined conditions. Inexperienced Group members' Happy Ratings for the photographs in the Three-Minute Sit (Neutral) condition ($M_{(Neutral)}$ = 2.60, SD = .91, Mean Rank = 10.79) were not significantly different from the Inexperienced Group's Ball (Happy) condition (Inexperienced $M_{(Happy)}$ = 2.40, SD = .88, Mean Rank = 10.35), z = -1.11, $p > .265$. On the average, the Experienced Group rated the Ball (Happy) condition higher ($M_{(Happy)}$ = 3.05, SD = .87, Mean Rank = 10.23) than they did the Three-Minute Sit (Neutral) condition ($M_{(Happy)}$ = 2.83, SD = .72, Mean Rank = 6.75), but this difference was not statistically significant, z = 1.708, p = .088.

Accepted Manuscript

ACCEPTED MANUSCRIPT

Overall, there was no difference in accuracy of responding between the two groups in rating emotions for the Ball condition. When happy was keyed as being correct for the three-minute-sit condition, the average percent correct in the neutral condition was 52% (Pooled M = .52, SD = .08; Inexperienced M = .53, SD = .09 and Experienced M = .51, SD = .08), t (48) = -.89, p = .76, one-tailed. When the Three-Minute-Sit/Neutral Condition is excluded from the data, the overall correct response rate becomes 46% (Pooled M = .46, SD = .09), with no differences between the groups (Inexperienced M = .47, SD = .08; Experienced M = .44, SD = .10), t (48) = -1.09, p = .56, one-tailed.

[insert Figure 4 approximately here]

In the Reprimand condition, sadness and fear were indistinguishable for both groups. The Friedman's ANOVA for the pooled data in the Reprimand (Sad) Condition indicated a significant difference in the rankings on the emotionality ratings scales, χ^2 (5, N = 50) = 77.31, p < .001 (see Figure 4). For the pooled data, the Sad Rating Scale exhibited the highest rating (Pooled $M_{(Sad)}$ = 1.09, SD = .84, Mdn = 1.00). The Friedman's ANOVA for the Inexperienced Group indicated that there was a significant difference among the inexperienced participants' emotionality ranking scales, χ^2 (5, N = 25) = 36.92, p < .001. For the Inexperienced Group's data, the Sad Rating Scale exhibited the highest rating (Inexperienced $M_{(Sad)}$ = 1.13, SD = .88, Mdn = 1) and was significantly different from all rating scales except fear when examined with post hoc pairwise comparisons. For the Experienced Group, the Friedman's ANOVA indicated that there was a significant difference in emotionality ranking for them, χ^2 (5, N = 25) = 46.62, p < .001. For the Experienced Group's data, the Fear Rating Scale exhibited the highest rating (Experienced $M_{(Fear)}$ = 1.35, SD = .90, Mdn = 1) and experienced people had difficulty distinguishing sadness from surprise, disgust, and fear.

Accepted Manuscript

ACCEPTED MANUSCRIPT

In the Reprimand (Sad) condition when collapsing the data to percent correct by choosing the highest rated emotion as the chosen emotion, Experienced Group members, in addition to often choosing sadness as the highest rated emotion, tended to rate fear as being high, usually citing a submissive expression on the dog's face. Thus, often (38%) they identified fear as the highest ranked emotion instead of sadness (30%) in the Reprimand (Sad) condition.

[insert Figure 5 approximately here]

In the Jack-in-the-Box (Surprised) condition, the nonparametric assessment indicated the Experienced Group participants identified a happy emotional expression more often (M = 1.69, SD = 1.04) versus the Inexperienced Group (M = .59, SD = .89), χ^2 (5) = 59.76, $p < .001$, while the Inexperienced Group members identified a sad emotional expression on the dog's face more often (M = 1.08, SD = .84) versus the Experienced Group members (M = .64, SD = .69), χ^2 (5) = 36.15, $p < .001$ (see Figure 5).

A two-way ANOVA was used to assess the significance of an interaction of experience and the identification of the dog's expression, F (5,740) = 14.06, $p < .001$. Although the assumption of equal variance was violated, the sample size across groups was equal, so this violation was not deemed problematic. When follow-tests were done, Inexperienced Group members rated Sad (M = 1.08) as being significantly higher than the next highly rated emotion (Happy M = .59), t (74) = 2.24, $p < .05$. Experienced Group members rated Happy (M = 1.69) as being significantly higher than the next highly rated emotion (Surprise M = .96), t (74) = 3.80, $p < 001$.

When data were examined as a percent correct measure, members of the Experienced Group rated the dog's expression to be happy (50%). They chose the expected emotion of

Accepted Manuscript

ACCEPTED MANUSCRIPT

surprise only 25% of the time. In the same condition, participants in the Inexperienced Group most often judged the dog's expression to be sad (45%). They chose the expected emotion of surprise only 14 of the time.

[insert Figure 6 approximately here]

The Medicine (Disgust) condition somewhat mirrored the findings for the Reprimand (Sad) condition, with pooled data indicating that sadness was the highest rated emotion, χ^2 (5) = 87.78, $p < .001$ (see Figure 6). The ratings of experienced people were more diverse in this condition than were the ratings of the inexperienced participants. This condition was the most difficult for all of the participants and had the poorest level of performance as was evidenced by their responses when data were examined in terms of percent correct. Neither group chose the expected emotion consistently. In the Inexperienced Group, sad was chosen most often (39% of the time) and anger was selected second most (28% of the time). The expected emotion, disgust, was preferred only 13% of the time by members of the Inexperienced Group. The Experienced Group members chose sad most often (31%). Fear was selected 25% of the time, while anger was preferred 23%. They chose disgust only 12% of the time, which was below random responding (14%).

[insert Figure 7 approximately here]

Both Experienced, χ^2 (5) = 78.58, $p < .001$, and Inexperienced Groups, χ^2 (5) = 82.46, $p < .001$, identified anger in the Bad Guy (Anger) condition, as was the expectation (see Figure 7). Although both groups rated anger the highest, the Experienced Group rated anger significantly lower than the Inexperienced Group rated it (Experienced $M_{(Anger)}$ = 2.28, SD = .50, Mean Rank = 19.70; Inexperienced $M_{(Anger)}$ = 2.91, SD = . 94, Mean Rank = 31.30), U (N=50) = 167.50, $p <$

Accepted Manuscript

ACCEPTED MANUSCRIPT

.01. Interestingly, the Experienced Group also rated photographs in this condition as being happy more often than did the Inexperienced Group (Experienced $M_{(Happy)}$ = 0.49, SD = .46, Mean Rank = 32.16; Inexperienced $M_{(Happy)}$ = 0.08, SD = .24, Mean Rank = 18.84), U (N=50) = 146.00, $p < .01$.

When collapsed into percent correct data, pooled over Group, data indicate that anger was identified correctly 70% of the time. Experienced Group participants most often rated anger as the most highly ranked emotion only 59% of the time. Paradoxically, they sometimes incorrectly identified photos in the Bad Guy (Anger) condition as having the predominant emotion of happiness 19% of the time, which had been predicted by the experts when concordance was examined earlier. Inexperienced Group members most often correctly identified photographs in the Bad Guy condition as displaying anger most of the time (81%). Their most common (and not often) mistake in this condition was to judge these photographs as displaying surprise (only 8% of the time).

[insert Figure 8 approximately here]

For the Toenail Trim (Fear) condition, the highest ratings in both groups were on the Fear Rating Scale, but the Experienced Group rated the dog's fear to be much higher than did the Inexperienced Group (Experienced $M_{(Fear)}$ = 2.09, SD = 1.08, Mean Rank = 30.42; Inexperienced $M_{(Fear)}$ = 1.33, SD = 1.04, Mean Rank = 20.58), U (N=50) = 189.5, $p < .02$. The Surprise Rating Scale was the second highest rating scale for both groups. The Experienced Group participants rated the dog as being more surprised than did the Inexperienced Group members (Experienced $M_{(Surprise)}$ = 1.88; Inexperienced $M_{(Surprise)}$ = 1.15), U (N=50) = 180.50, p

Accepted Manuscript

ACCEPTED MANUSCRIPT

< .01. There were no other statistically significant findings for the Toenail Trim (Fear) condition.

In the Toenail Trim (Fear) condition, when examined as percent correct data, pooled across groups, emotion judged to be displayed in the dog's face was fear 45% of the time. When groups were examined individually, this was exactly the same percentage in each group. Surprise was the second most common choice of emotion in this condition when the data were pooled (37%), as in the Inexperienced Group (33%) and the Experienced Group (41%).

Overall, humans, inexperienced with dogs and substantially experienced with dogs, consistently identified happiness, sadness, anger, and fear in photographs of a dog's face when these emotions were expected to be displayed, given the behaviorally defined conditions the dog was experiencing at the time the photograph was taken. The conditions creating the most difficulty, for both inexperienced and experienced participants, were the surprise and disgust conditions. Photographs expected to convey a surprised façade (Jack-in-the-Box) instead appeared to communicate curiosity and inquisitiveness, which participants of both groups and an earlier group of experts all identified as such. Photographs expected to display disgust, more often communicated sadness. Unfortunately (but not to Mal), due to the dog's overall happy temperament and disposition, photographs that were expected to display a neutral façade had a component of happiness in them. Thus, there apparently was really not a neutral condition to examine.

3.3 Behavioral Situations.

[insert Figure 9approximately here]

Accepted Manuscript

ACCEPTED MANUSCRIPT

Overall responding, pooled over groups and over situations, indicated that human's ability to identify communicative signaling (i.e., the situation the dog was actually experiencing) in photographs of expressions of a dog's face was above chance responding of 14%. Raters, in general, were correct 41% of the time, t (49) = 17.53, p = .001, two-tailed. When humans were broken into groups of experienced and inexperienced people, both groups performed significantly over chance responding. Experienced people were correct 45% of the time ($SD_{Experienced}$ = .12), t (24) = 12.95, p = .001, two-tailed. Inexperienced people were correct 38% of the time ($SD_{Inexperienced}$ = .09), t (24) = 13.65, p = .001, two-tailed, respectively. The difference (7%) in accuracy between the two groups was statistically significant, t (48) = 2.55, p = .014, two-tailed.

When the specific situations are examined, both groups were very good at identifying when the dog was about to play ball (Pooled 77% of the time), with no significant differences between groups, t (48) = -0.39, $p < .70$, and when the dog was being teased by a bad guy (77% of the time), with no significant differences between groups, t (48) = -0.43, $p < .70$ (see Figure 9). Although here were no differences between groups in these conditions, experienced humans' most common mistake was to identify the teased dog as being in the situation of playing ball.

Both groups were poor at identifying a dog that had just taken a distasteful medication, as both groups responded below chance responding in this condition. Both groups confused this condition with the Bad Guy and the Reprimand conditions.

In the Reprimand condition, the pooled data indicated that people, in general, identified this situation correctly 39% of the time. However, when the data were examined in the separate groups, Experienced Group participants (49% correct) were correct more often than were Inexperienced Group members (29% correct) and this difference was statistically significant t

Accepted Manuscript

ACCEPTED MANUSCRIPT

(48) = -2.84, $p < .007$. Inexperienced people often (22%) mistook this condition for the Toenail Trim condition.

In the Jack-in-the Box condition, Experienced Group members were correct 34% of the time. Inexperienced Group participants were correct only 12% of the time. This difference was statistically significant, t (48) = -3.02, $p < .004$. Much more often than experienced people, inexperienced people confused this condition with the Three-Minute-Sit (32%) and Reprimand (28%).

In the Toenail Trim, pooled responding indicated that 44% of the time this situation was identified as the Medicine condition. This was true for both groups (Experienced = 41%; Inexperienced = 48%). Differences between the two groups were not significant in this condition, t (48) = 1.17, $p < .249$. Qualitative comments regarding the dog displaying its tongue appeared to affect judgments in this condition.

In the Three-Minute Sit condition, the pooled data indicated that the most common response was the Ball situation (56%) while correct situation (Three-Minute-Sit) was selected 39% of the time. Experienced Group members chose the Ball situation 52% of the time, while Inexperienced Group participants chose the Ball situation 60% of the time. Differences between the two groups were not statistically significant in this condition, t (48) = -1.23 $p < .225$.

4. Discussion

Research examining facial recognition in non-human animals indicates that social animals, including sheep (Kendrick, da Costa, Leigh, Hinton, & Pierce, 2001) and even paper wasps (Sheehan & Tibbetts, 2011), use faces to facilitate maintaining their social structure. Given the social bonds between humans and dogs, and the importance of reading emotional cues to facilitate social interactions, it seems reasonable to believe that humans would attend to a

Accepted Manuscript

ACCEPTED MANUSCRIPT

dog's facial displays of emotion. Anecdotal accounts have long suggested that dogs visually express emotions through their faces, as well as through their entire bodies (Darwin, 1872/1998; McConnell, 2006; Robinson, 2005a, 2005b). It has been clearly shown through extensive research on human facial expressions by Ekman (e.g., 1993) that facial expressions alone, without other bodily cues, can be sufficient for expressing understandable emotions. It has also been found that, when examining humans' ability to classify dog barks recorded in different situations (Pongracz et al., 2005), emotional ratings were in accordance with expectations about specific situations (e.g., during teasing by a "bad guy"). Combining these two strands of research led us to explore whether sufficient information about emotions can be obtained just from the facial expressions of a dog. In this regard, we found that humans were able to classify, well above chance responding, the emotions conveyed by photographs of facial expressions of a dog that was experiencing emotion-evoking situations.

When identifying ability to perceive emotions from a dog's face, there was little difference between experienced and inexperienced people, indicating that learning may not play a large role in this ability to read a dog's emotion via its facial expression. Moreover, most errors were similar across the experienced and inexperienced groups (e.g. mistaking sadness for disgust and surprise for fear), further suggesting that humans are judging specific features presented in the facial expressions in dogs and that something universal may be happening. Just as Pongracz et al. (2005) found that humans seem to be noticing specific auditory parameters in dog vocalizations as had been described among other species by Morton (1977), it appears that humans are noticing specific details in facial muscle tension in dogs, as Ekman and his colleagues have found to be true across cultures in humans.

Accepted Manuscript

ACCEPTED MANUSCRIPT

Regarding the emotionality ratings, an unexpected result in our study was that, in the Three-Minute-Sit condition, expected to produce a neutral façade for comparison purposes, often experienced and inexperienced participants judged the dog's expression to be happy. We attributed to Mal being a happy dog who was generally seen as displaying a happy face when in the neutral condition. Another explanation is that perhaps the resting position of a dog appears to be happy, as with dolphins' perpetual smiles. Or, perhaps, during the domestication process, humans selected for dogs that demonstrate more positive affect. Thus, a major difference between wolves and dogs may be a tendency toward positive affect ("friendly toward experimenters") that most likely accompanied domestication (Trut, 1999, p. 163).We now believe that creating a neutral facial expression may be near impossible. It is noteworthy that Parr, Waller, Vick, and Bard (2007) also had difficulty developing neutral faces in chimpanzees. When examining human facial expressions, Ekman and Friesen (2003, p. 142), described a neutral facial expression as appearing to be "wooden or tense," which suggests that this may be artificial, even in humans.

A second unexpected result in the emotional ratings was the divergence between experienced and inexperienced participants when judging emotionality during the Jack-in-the-Box (Surprise) condition. Our experts described the dog as appearing to be "curious." This judgment was reiterated by both the experienced and inexperienced participants when identifying this emotion. The experienced participants appeared to use a cognitive process of trying to ascertain what basic emotions presented to them could best describe curiosity or inquisitiveness, which they believed they were viewing, and hence, often concluded the best answer would be happy. The inexperienced people focused on the dog's wrinkled forehead, and thus, determined that he was expressing sadness.

Accepted Manuscript

ACCEPTED MANUSCRIPT

When people viewed the Medicine (Disgust) condition, their responding was below chance levels. In qualitative comments, experienced and inexperienced participants appeared to be focused on the dog's wrinkled muzzle. In humans, a display of the nasolabial furrow indicates extreme sadness (Ekman, 2003), which may be leading to the most popular answer (sad) in this condition. This interpretation is post hoc and based on serendipitous qualitative statements.

One incongruous observation is that, when identifying anger in dogs, inexperienced people were more capable than experienced people. Meints, Racca, and Hickey (2010) found that children often mistake a snarling dog that is showing its teeth as being a smiling, and thus a happy, dog, which can be a fatal mistake. From our results, it appears that people who have experience with dogs are more likely to make this common children's error. Perhaps, it could be that people who spend time with dogs are more likely to give dogs the benefit of the doubt as being friendly by perceiving dogs' emotions as being less aggressive.

The few previous studies examining human identification of canine facial expression utilized haphazard selection procedures. Gross (2004) examined human processing of dogs' facial expressions, but the photographs of the dogs were not standardized or consistently anchored in any kind of behavioral situation. Methods used to produce photographs in Gross's study were undefined and some appeared to be "photoshopped" composites of bizarre features in an attempt to depict Ekman's AU's in other species. In another recent study, photographs of dogs displaying emotion apparently confound the breed of the dog with the emotion being examined (e.g., by using a German Shepherd, typically considered to be an aggressive breed, to illustrate an aggressive emotion, while using a Border collie, typically considered to be an obedient breed, to illustrate a happy expression; see photographs used in Racca, Guo, Meints, & Mills, 2012). Racca and colleagues used some photographs "taken in different situations associated with

Accepted Manuscript

ACCEPTED MANUSCRIPT

different emotional states" (p. 2); however, there was little description of these situations and two of the photographs were simply selected from secondary sources (e.g., off the Internet) because they fit arbitrary notions of the researcher's idea of the kind of features a given emotion would display. Future studies would benefit from a set of standardized photographs of dogs' faces that are anchored in behaviorally defined situations and have shown established reliability and validity, such as we have provided in our present study. This would be superior to using photographs that are arbitrarily selected via researchers' preconceived notions of the appearance of an angry or happy dog. Consequently, we propose that future research on human abilities to identify dogs' facial expression would benefit from the development of a wider catalog of photographs that are anchored in behaviorally defined situations and use several different breeds. Such a catalog would provide an important tool for future research, and could be examined in various ways, such as for reliability and validity.

When identifying behavioral situations, often, experienced people seemed to have an advantage. The superior ability of the experienced group on this task may well be that experienced people have specific knowledge of how a dog will react to given conditions. For example, they may know a dog will tend to be fearful of toenail trimmers, but not so much of taking medicine. In the study, inexperienced people were often at a loss as when interpreting how a situation would affect a dog. They tended to focus on the fact that they did not know how the situations would affect the dog, as opposed to when they were asked what emotion was being displayed, which they understood without question. That is, inexperienced people apparently understood happy, sad, angry, fearful, disgusted, and surprised, but did not understand "giving a dog medicine" or "reprimanding a dog." Further research on the extent that there might be innate capacities to recognize emotions in canines, related to the two species long shared history

Accepted Manuscript

ACCEPTED MANUSCRIPT

or common mammalian ancestry, versus that this might be more related to learning, are warranted. The one paradoxical and noteworthy result we found, of experienced people misidentifying anger in dogs more often than inexperienced people, also merits replication.

In order to examine human ability to identify emotional expression in dogs, applying Ekman and colleagues (1978, 2002a, 2002b) FACS could be another focus for future research. To code specific facial action units in dogs such as Parr and colleagues (2007 & 2008) have done in chimpanzees would facilitate the study of emotions in mammals. To compare and contrast how humans differentially make sense of the emotions of dogs, close social companions, and of chimpanzees, close genetic relatives, could be an important avenue into understanding how humans process emotional information. Pongracz et al. (2005, p.143) concluded, "Basic emotions and the ability to recognize them is an ancient capability shared by animals and humans." Additionally, they suggest that humans have selected for dogs that bark reliably in accordance with their behavioral and emotional situations, and that the domestication process has made dogs more human oriented. Perhaps humans have similarly selected for dogs that reliably display familiar facial expressions that can be easily deciphered, and that dogs are sensitive enough to us to display these expressions accordingly.

As advised by Ekman (2003) when discussing human-to-human communication via facial expression, even though there are universal action units specifying emotions, instruction in correct interpretation of facial expression can aid the perceiver in more accurately assessing the intent and behavior of the sender. On such a practical level in considering dogs' facial expressions, teaching humans to more accurately identify dogs' communicative signaling has benefits. Dog bites could be reduced, thus improving public safety. Performance in handlers who work with dogs could be enhanced. The quality of working dogs' lives could be improved

Accepted Manuscript

ACCEPTED MANUSCRIPT

because their emotional state could be noted and considered. Computer-assisted simulations of dogs' expressions could also be developed to assist people in reading their dogs in all of these, and possibly more, venues.

Among the limitations of our study, we used just one breed of dog. Considering that dogs have widely varying morphologies, our results may not apply to other breeds. In fact, we chose this one breed to maximize the likelihood of finding positive results, as it appears closer to non-domesticated canids than many other breeds. Another limitation is that, although we used behavioral situations as did Pongracz et al (2005) to induce the various expected emotional conditions in dogs, we used no corroborating physiological measures (e.g., heart rate, cortisol, etc.) to independently verify emotionality. Additionally, we examined one type of experience with dogs (AKC obedience), while other types of relationships with dogs, such as in working dog handlers or hunters, may focus more on their dogs' emotional displays. These limitations present directions for future studies that could build upon our work.

5. Conclusions

We have shown that humans were able to accurately, but not perfectly, identify at least one dog's facial expressions, anchored in behavioral situations that were expected to produce specific emotions. The basic question remains, whether this ability results from a common mammalian lineage or has been enhanced by our long shared history. Our research has implications for improving performance in working dog relationships such as therapy, assistance, law enforcement, military, and pest control dogs. Both basic and applied inquiries would benefit from standardized, behaviorally anchored photographs. Last, although humans often tend to think of themselves as disconnected or even isolated from nature, our study suggests that there are patterns that connect (Bateson, 1979) humans to other species, and one of these patterns of

Accepted Manuscript

ACCEPTED MANUSCRIPT

interconnectedness is in the form of emotional communication.

References

American Kennel Club Obedience Rules, (2008). Retrieved October 18, 2008, from http://www.canismajor.com/dog/cdxtitle.html.

Barker, S. B. (1999). Therapeutic aspects of the human-companion animal interaction. *Psychiatric Times, 16* (2), 45–55.

Bateson, G. (1979). *Mind and nature: A necessary unity (Advances in systems theory, complexity, and the human sciences).* New York: E.P. Dutton.

Bloom, T. (2011). Human ability to recognize dogs' (*Canis familiaris*) facial expressions: From cross cultural to cross species research on the universality of emotions. (Doctoral dissertation, 2011). *UMI/ProQuest, 3469598,* 284.

Bolwig, N. (1964). Facial expression in primates with remarks on a parallel development in certain carnivores. *Behaviour, 22,* 167–192.

Bracha, H. S. (2006). Human brain evolution and the "Neuroevolutionary Time-depth Principle:" Implications for the reclassification of fear-circuitry-related traits in the DSM-V and for studying resilience to warzone-related posttraumatic stress disorder. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 30,* 827–853.

Bracha, H. S., & Maser, J. D. (2009). Anxiety and posttraumatic stress in the context of human brain evolution: A role for theory in the SM-V. *Clinical Psychology: Science and Practice, 15*(1), 91–97.

Darwin, C. (1872/1998). *The expression of the emotions in man and animals.* New York: Oxford University Press.

Davis, S. J. M., & Valla, F. R. (1978). Evidence for domestication of the dog 12,000 years ago in the Natufian of Israel. *Nature, 276,* 608–610.

Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science, 11,* 86-89.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48* (4), 384–370.

Ekman, P. (1994). Strong evidence for universals in facial expressions: A reply to Russell's'mistaken critique. *Psychological Bulletin, 115* (2), 268–287.

Ekman, P. (1997). Expression or communication about expression. In Segal, N. L.,Weisfeld, G. E., Weisfeld, C. C. (Eds.), *Uniting psychology and biology: Integrative perspectives on human development,* pp. 315–338. Washington, DC: American Psychological Association.

Accepted Manuscript

ACCEPTED MANUSCRIPT

Ekman, P. (1999). Chapter 16: Facial expressions. In Dalgleish, T., & Power, M. (Eds.). *Handbook of cognition and emotion*, pp. 301 – 320. New York: John Wiley & Sons Ltd. www.paulekman.com/pdfs/facial_expression.pdf, *Retrieved January 25, 2009.*

Ekman, P. (2003). *Emotions revealed: Recognizing faces and feelings to improve communication and emotional life.* New York: Henry Holt and Company.

Ekman, P., & Friesen, W. V. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica, 1*, 49–98.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face of emotion, *Journal of Personality and Social Psychology, 17*, 124–129.

Ekman, P., & Friesen, W.V. (1974). Nonverbal behavior and psychopathology. In R.J. Friedman & M. Katz (Eds.), *The psychology of depression: Contemporary theory and research* (pp. 3–31). Washington, DC: Winston & Sons.

Ekman, P. & Friesen, W. V. (1976). *Pictures of facial affect.* Palo Alto, CA: Consulting Psychologists Press.

Ekman, P., & Friesen, W.V. (1978). *Facial action coding system: A technique for the measurement of facial movement.* Palo Alto, CA: Consulting Psychologists Press.

Ekman, P., & Friesen, W. V. (2003). *Unmasking the face: A guide to recognizing emotions from facial clues.* Cambridge, MA: Maylor Books.

Ekman, P., Friesen, W.V., & Hager, J.C. (2002a). *Facial action coding system: The investigator's guide.* Salt Lake City, UT: Research Nexus.

Ekman, P., Friesen, W.V., & Hager, J.C. (2002b). *Facial action coding system: The manual.* Salt Lake City, UT: Research Nexus.

Ekman, P., Friesen, W. V., O'Sullivan, M., Diacoyanni-Tarlatzis, I., Rainer, K., Pitcarin, T. et al. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology, 53* (4), 712-717.

Ekman, P., & Oster, H. (1979). Facial expressions of emotion. *Annual Review of Psychology, 30*, 527–554.

Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science, 164*, 86-88.

Fox, M. W. (1970). A comparative study of the development of facial expressions in canids; wolf, coyote, and foxes. *Behaviour, 36*, 4–73.

Furrer, R. D., & Manser, M. B. (2009). The evolution of urgency-based and functionally-based alarm calls in ground-dwelling species. *The American Naturalist, 173* (3), 400–410.

ACCEPTED MANUSCRIPT

Gross, T. F. (2004). The perception of four basic emotions in human and nonhuman faces by children with autism and other developmental disabilities. *Journal of Abnormal Child Psychology, 32* (5), 469–480.

Groves, C. P. (1999). The advantages and disadvantages of being domesticated (A keynote address). *Perspectives in Human Biology, 4* (1), 1–12.

Isack, H. A., & Reyer, H. U. (1989). Honeyguides and honey gatherers: Interspecific communications in a symbolic relationship. *Science, 243,* 1343 – 1346.

Kendrick, K. M., da Costa, A. P., Leigh, A. E., Hinton, M. R., Pierce, J. W., (2001). Sheep don't forget a face. *Nature, 414,* 165 – 166.

McConnell, P. B. (2006). *For the love of a dog: Understanding emotion in you and your best friend.* New York: Ballentine Books.

McConnell, P. B., & Baylis, J.R. (1985). Interspecific communication in cooperative herding: Acoustic and visual signals from human shepherds and herding dogs. *Zeitschrift fur Tierpsychologie, 67,* 302-382.

Meints, K., Racca, A., & Hickey, N. (2010). How to prevent dog bite injuries? Children misinterpret dogs' facial expressions. *Injury Prevention, 16,* Abstract. 1136.

Morton, E. S. (1977). On the occurrence and significance of motivation structural rules in some bird and mammal sounds. *American Naturalist, 111*, 855–869.

Nobis, G. (1979). Der alteste Haushund lebte vor14,000 Jaren. *UMSHAU, 19,* 610.

Odendaal, J. S. (2000). Animal-assisted therapy; Magic or medicine? *Journal of Psychosomatic Research, 49,* 275-280.

Parr, L. A., Waller, B. M., & Heintz, M. (2008). Facial expression categorization by chimpanzees using standardized stimuli. *Emotion, 8* (2), 216–234.

Parr, L. A., Waller, B. M., Vick, S. J., & Bard, K. A. (2007). Classifying chimpanzee facial expressions using muscle action. *Emotion, 7* (1), 172–181.

Paxton, D.W. (1994). *Urban Animal Management: A naturalistic perspective*. Unpublished doctoral dissertation, Australian National University.

Paxton, D. W. (2011). *Why It's OK to Talk to Your Dog: Co-evolution of People and Dogs*. Salisbury, Brisbane, Australia: Watson Ferguson & Company.

Pongracz, P., Molnar, C., & Miklosi, A. (2006). Acoustic parameters of dog barks carry emotional information for humans. *Applied Animal Behavior Science, 100,* 228-240.

Pongracz, P. Molnar, C., Miklosi, A., & Csanyi, V. (2005). Human listeners are able to classify dog (*Canis familiaris*) barks recorded in different situations. *Journal of Comparative*

Accepted Manuscript

ACCEPTED MANUSCRIPT

Psychology, 119 (2), 136–144.

Racca, A., Guo, K., Meints, K., & Mills, D. (2012). Reading faces: Differential lateral gaze bias in processing canine and human facial expressions and in dogs and 4-year-old children. *Plus One, 7*(4), e36076, Retrieved October 8, 2012.

Robinson, S. (2005a). Canine aggression. *Schutzhund USA, 30* (3), 32-38.

Robinson, S. (2005b). Human-directed dog aggression, evaluation, treatment, and methodology. *Schutzhund USA, 30* (5), 60-63.

Ruys, K. I., & Stapel, D. A. (2008). Emotion elicitor or emotion Messenger? Subliminal priming reveals two faces of facial expression. *Psychological Science, 19* (6), 593–600.Sable, P. (1989). Attachment, anxiety, and loss of a husband. *American Journal of Orthopsychiatry, 59,* 550-556.

Seyfarth , R., & Cheney, D, (1990). The assessment of vervet monkeys of their own and another species alarm calls. *Animal Behaviour, 40,* 754 – 764.

Sheehan, M. J., & Tibbetts, E. A. (2011). Specialized face learning in association with individual recognition in paper wasps. *Science, 334*, 1272 – 1275.

Shriner, W. M. (1998). Yellow-bellied marmot and golden mantled ground squirrel responses to heterospecific alarm calls. *Animal Behaviour, 55,* 529 – 536.

Trut, L. N. (1999). Early canid domestication: The farm-fox experiment. *American Scientist, 87,* 160 – 169.

Vila, C., Savolainen, P., Maldonado, J. E., Amorim, I.E., Honeycutt, R. L., Crandall, K. A., Lundeberg, J., & Wayne, R. K. (1997). Multiple and ancient origins of the domestic dog. *Science, 276,* 1687-1889.

Wilson, M., & Knoblich, G., (2005). The case for motor involvement in perceiving conspecifics. *Psychological Bulletin, 131*, 460-473.

Accepted Manuscript

ACCEPTED MANUSCRIPT

Table 1

Mean Ranks of all Photographs

Photo	Ball	Reprimand	Jack-Box	Medicine	Toenail	Bad Guy	3-Min Sit
Photo 1	7.00	*2.00	4.67	8.67	*1.33	5.00	*3.00
Photo 2	8.00	8.00	4.33	4.00	*2.00	3.67	10.00
Photo 3	*2.67	6.33	*3.00	5.00	*2.67	6.00	8.00
Photo 4	10.00	5.00	*1.67	*2.00	7.00	10.00	4.33
Photo 5	9.00	*1.33	6.33	*2.33	4.00	*3.00	9.00
Photo 6	*1.67	10.00	6.67	10.00	5.00	9.00	*1.00
Photo 7	6.00	4.00	8.33	6.33	8.00	*1.33	4.67
Photo 8	4.33	9.00	8.67	6.67	9.00	*2.00	*2.00
Photo 9	*2.00	6.67	10.00	*1.67	6.00	7.33	7.00
Photo 10	4.33	*2.67	*1.33	8.33	10.00	7.67	6.00

Note. *Photographs selected as stimuli for remainder of the study. Three experts' average rank ordering of the 70 photographs is displayed. Each column represents a behaviorally defined condition. Each cell in the column indicates the rank, averaged across the three judges, of the photograph listed for that row. For example, Photograph 4 in the Ball condition was the "worst" photograph for that condition by all three judges, while Photograph 6 was rated best for the 3-Minute Sit condition by all three judges.

Accepted Manuscript

ACCEPTED MANUSCRIPT

Table 2

Confusion Matrix of Correct and Incorrect Emotion Identifications for Pooled Data

Behavioral Situation (Expected Emotion)	Perceived Emotion						
	None[a]	Happy	Sad	Surprise	Disgust	Anger	Fear
3-Min Sit (Neutral)	0.7[b]	92.0	0.7	6.7	0.0	0.0	0.0
Ball (Happy)	0.0	88.0[b]	0.7	9.3	0.0	0.0	2.0
Reprimand (Sad)	0.7	5.3	36.7[b]	10.0	12.7	2.0	32.7
Jack-in-Box (Surprise)	3.3	36.0	32.7	20.0[b]	4.0	0.0	4.0
Medicine (Disgust)	0.0	3.3	34.7	6.0	12.7[b, c]	25.3	18.0
Bad Guy (Anger)	0.0	10.7	0.0	9.3	2.0	70.0[b]	8.0
Toenail Trim (Fear)	0.0	4.7	4.0	37.3	7.3	1.3	45.3[b]

Note. These numbers represent the percentage of responses of a given emotion being rated highest for each behavioral situation and resulting expected emotion. Thus, across a row, the sum is 100. In this table, correct is considered to be when highest rated emotion matches expected emotion. When pooled over all of the emotions, the correct emotion was identified, on average, only 39% of the time—that is, the emotions were incorrectly identified the majority of the time (61%). [a] For the column labeled "None," all rating scales were scored "0." [b] On the diagonal, Highest Rated Emotion reflects Expected Emotion; that is, the diagonal indicates percentage of correct answers, given expectations. [c] Medicine (Disgust) was the only condition that was judged incorrectly less than expected by chance responding (14%, or 1 in 7 possible outcomes which are reflected in the column labels).

Accepted Manuscript

ACCEPTED MANUSCRIPT


3-Min Sit 1


3-Min Sit 6


3-Min Sit 8


Ball 3


Ball 6


Ball 9


Jack Box 3


Jack Box 4


Jack Box 10


Reprimand 1


Reprimand 5


Reprimand 10

ACCEPTED MANUSCRIPT

Figure 1. The 21 Photographs chosen by the experts as best representations of the specified conditions.
All photographs were taken by Keith Reynolds of Barnwood Gallery, Utica Pennsylvania. Copyright owned by Tina Bloom.

Accepted Manuscript

ACCEPTED MANUSCRIPT

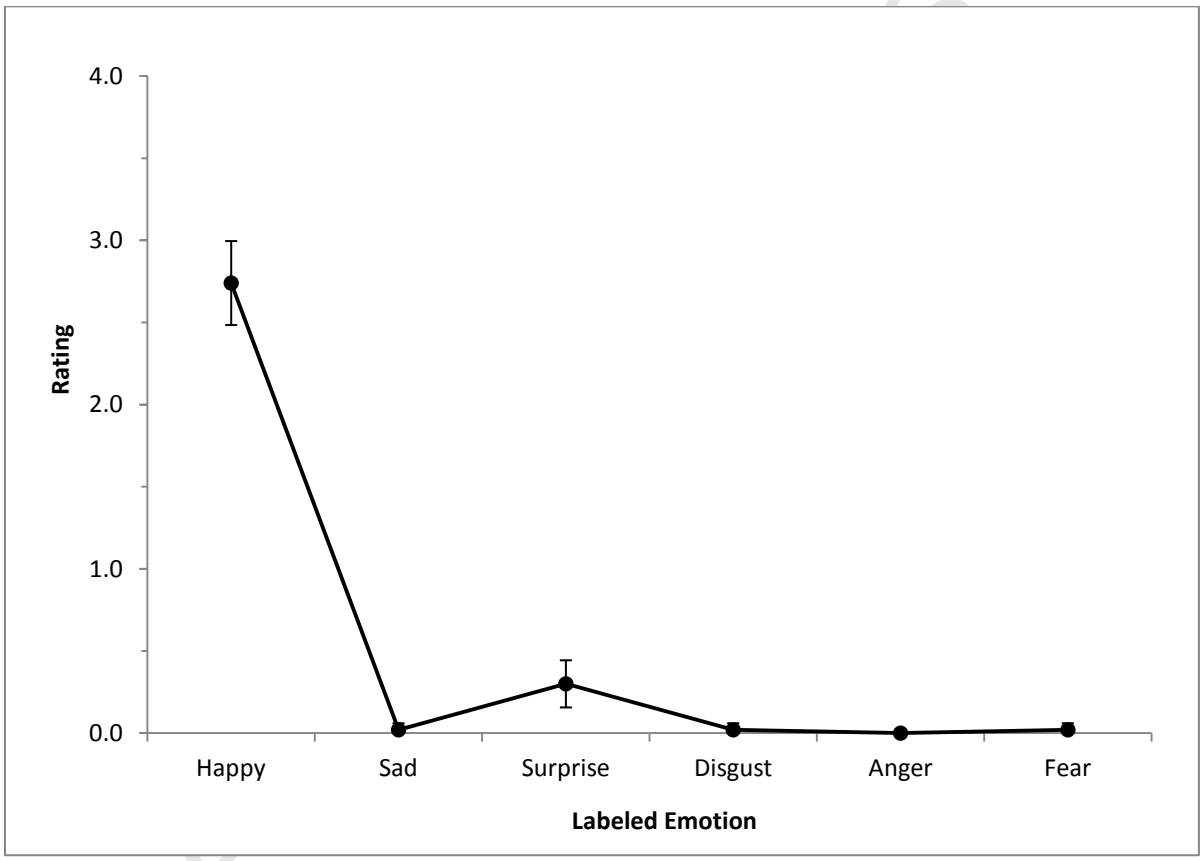

Figure 2. Three-minute-sit (neutral) condition's emotionality ratings pooled over both groups. Group responding was virtually parallel across all rating scales and the happy rating scale was rated highest. The rating scales ranged from *0* to *4*.

ACCEPTED MANUSCRIPT

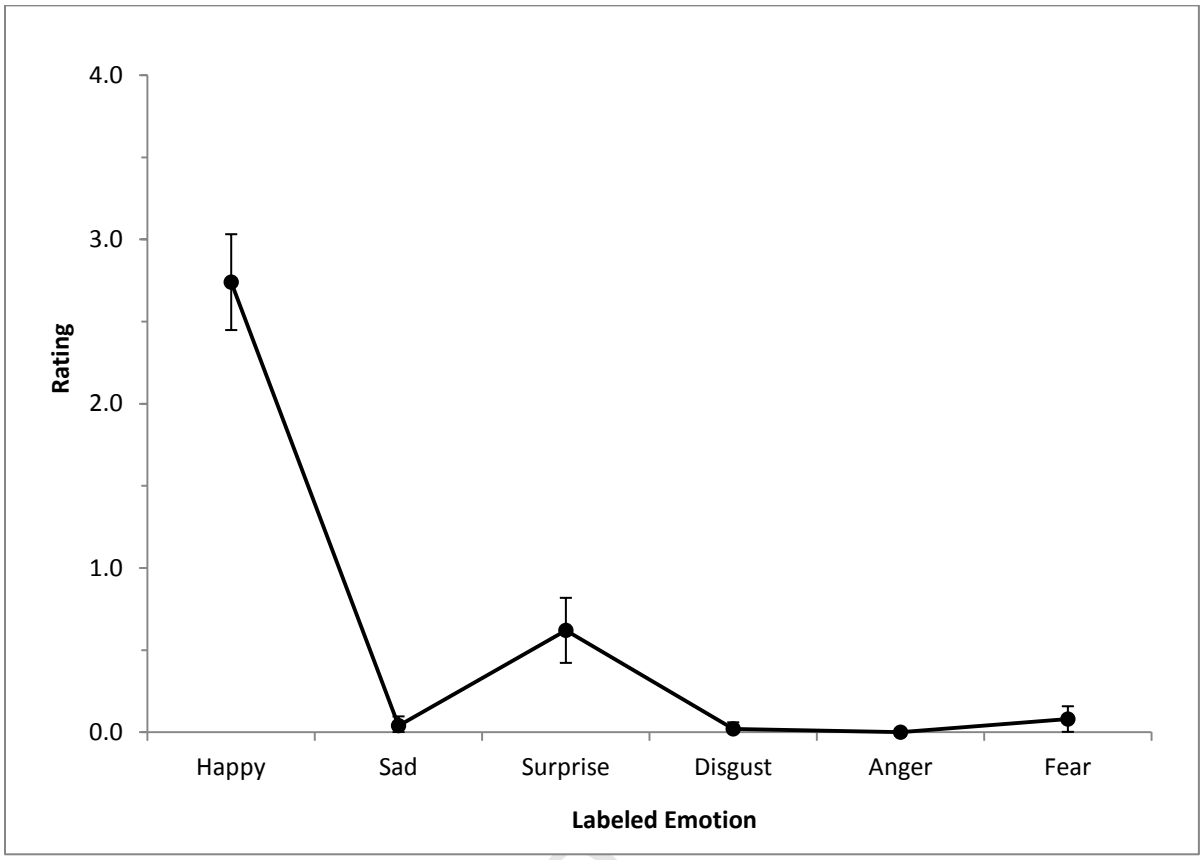

Figure 3. Ball (happy) condition's emotionality ratings pooled over both groups. Group responding was virtually parallel across all rating scales and the happy rating scale was rated highest. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

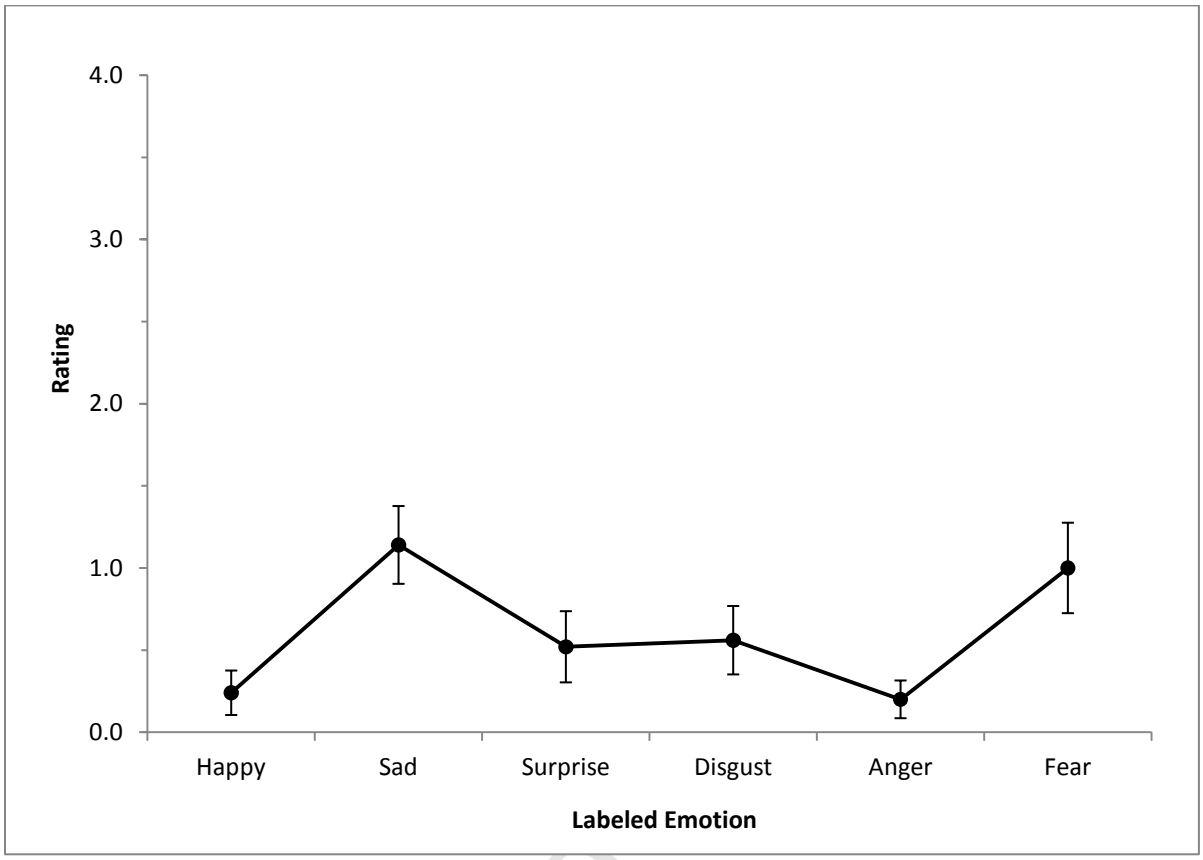

Figure 4. Reprimand (sad) condition's emotionality ratings pooled over both groups. Both groups' responding indicated highest ratings on both sad and the fear rating scales. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

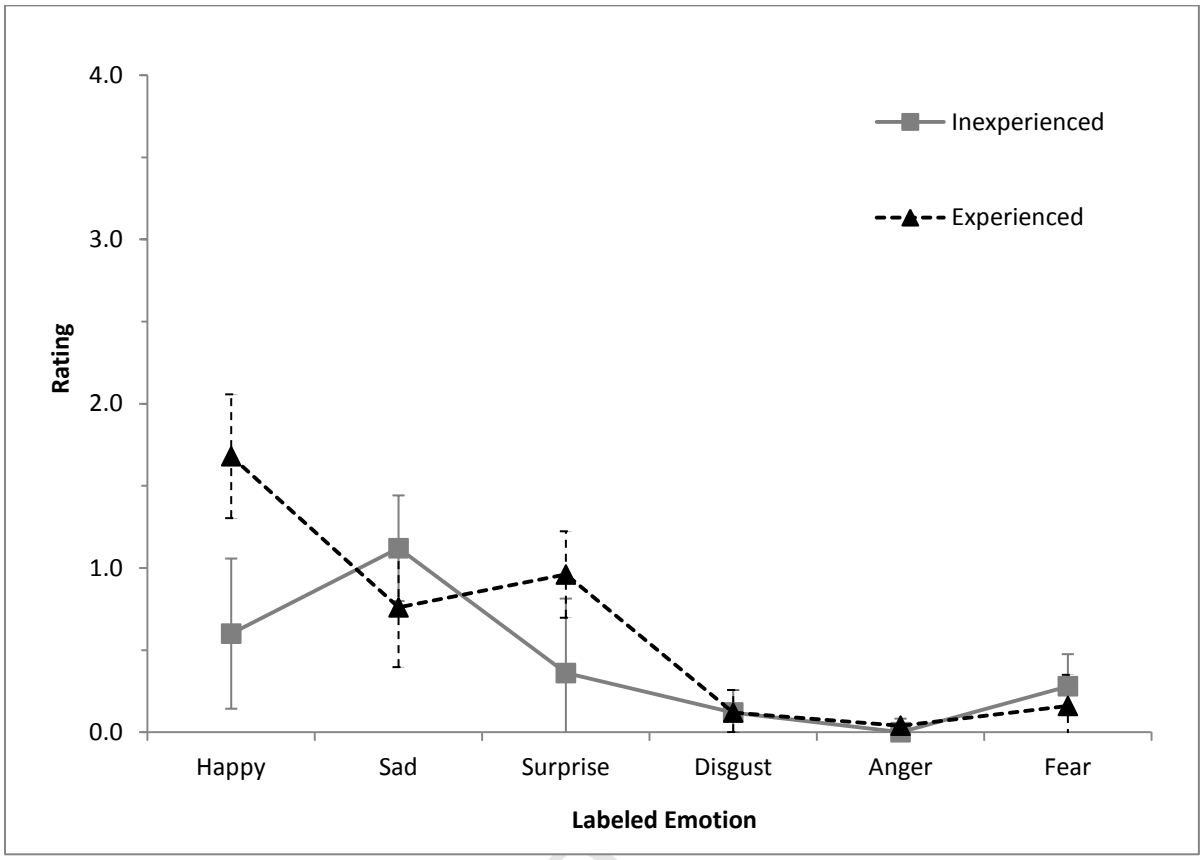

Figure 5. Jack-in-the-box (surprise) condition's emotionality ratings. Groups diverged, displaying an interaction with emotionality rating, in their judgments across the rating scales during this condition. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

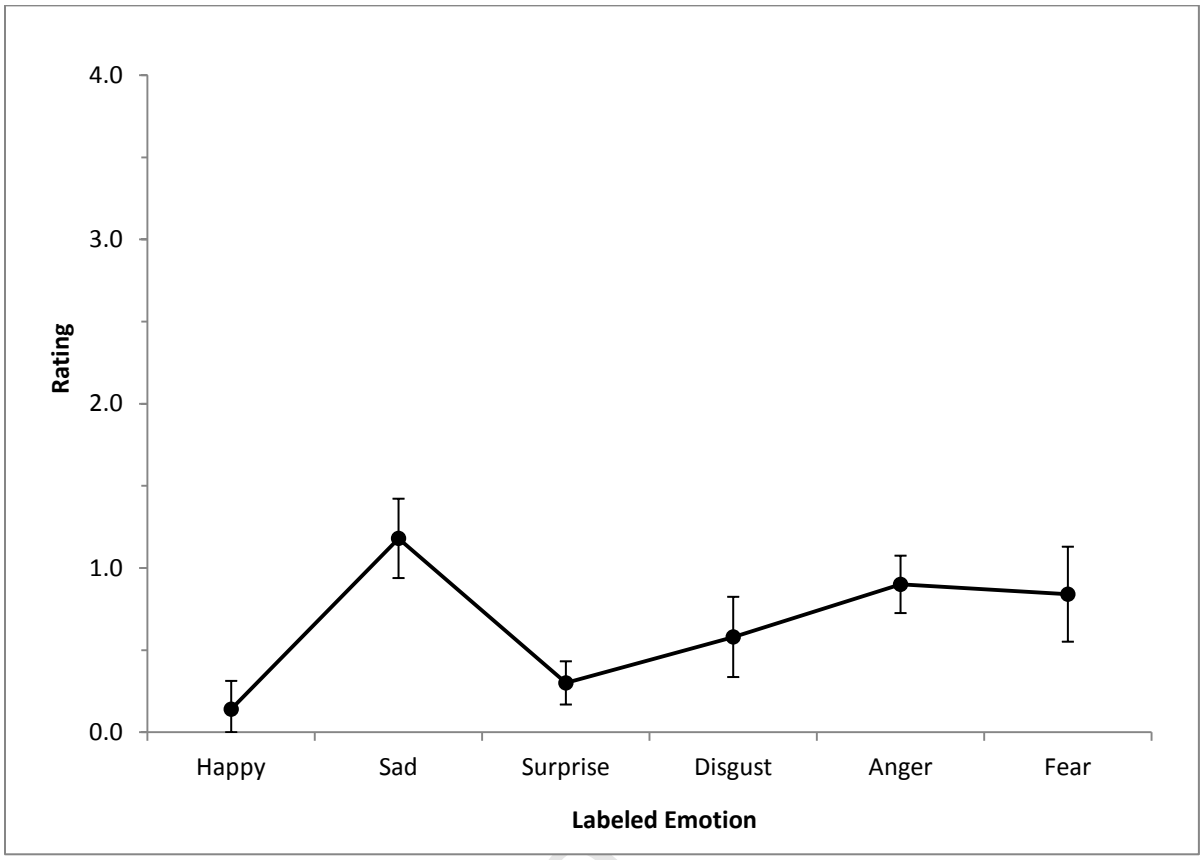

Figure 6. Medicine (disgust) condition's emotionality ratings pooled over both groups. Neither group preferred the disgust scale during this condition. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

Figure 7. Bad Guy (anger) condition's emotionality ratings pooled over both groups. Both groups show similar trends in this condition. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

Figure 8. Toenail trim (fear) condition's emotionality ratings pooled over both groups. Groups show parallels in this condition. Both groups rate surprise just behind fear. The rating scales ranged from *0* to *4*.

Accepted

ACCEPTED MANUSCRIPT

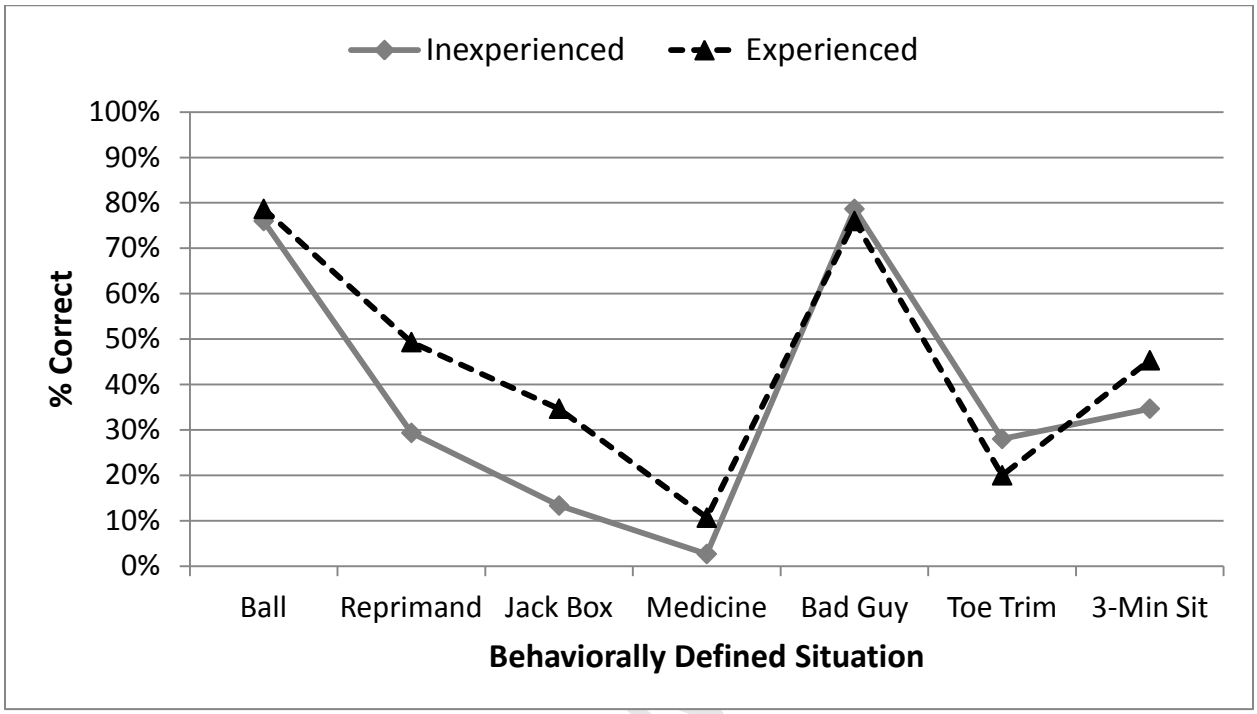

Figure 9. Percentages of correctly categorized situations. In this figure correctly categorized means that the situation selected by the participant matches the situation the dog was experiencing.

Accepted Manuscript