THE ROLE OF EXPERIENCE IN THE HUMAN PERCEPTION OF EMOTION IN DOGS

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ABSTRACT

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To investigate the role of experience in interspecific emotion perception, humans with various levels of dog experience provided their interpretations of emotion in dogs using the dogs’ visual signals (body language). First, a set of 30 short videos of dogs was assembled, and a panel of eight behavioral experts provided ratings and categorizations of the depicted dogs’ emotions. Based on the emotional valence and level of agreement in their ratings, a subset of 16 videos was selected for inclusion in a web survey made available to the general public. The wide range of dog experience found within the final sample of 2,163 participants allowed for various means of assessing the effect of experience. Responses were analyzed according to broad experience categories (never owned a dog, dog owner, dog professional for less than ten years, dog professional for ten or more years), as well as experience-related variables among the dog owners.

Effects on emotion perception were found using all experience-related measures. The level of experience with dogs predicted both ratings and categorizations of emotion in dogs. The role of experience was more evident for emotional displays that had been judged by experts to be clearly negative than clearly positive. Less-experienced individuals tended to provide more positive emotion ratings of negatively-valenced behavior than more-experienced individuals. In addition, they were more likely to diverge from expert evaluations and categorize such behavior as happy, rather than
fearful. Furthermore, as previous education about dog body language increased among more-experienced individuals, perceptions became more aligned with expert evaluations, while perceptions of individuals who had never owned a dog became less aligned. Lastly, differences among the experience groups in emotion ratings and categorizations were reflected in differences in observational focus. Individuals with greater experience were more likely to attend to the ears of the dog and less likely to attend to the legs and tail. In sum, individual differences in dog experience were associated with the perception of emotion in dogs, suggesting experience-dependent development of these abilities. These findings are among the first to provide evidence for experience-associated variation in interspecific emotion perception and may illustrate a novel strategy for exploring the development of individual differences in emotion perception in humans.
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DEDICATION

To Thorsten, who always sees the big picture

To Tiger, who makes us laugh
CHAPTER 1

INTRODUCTION

I begin with a short story to illustrate the rationale for this dissertation: In 2005, I attended a dog training seminar that included a lecture about dog body language. The presenter showed several photographs of dogs to a room of eager dog owners and dog behavior professionals and explained how the dogs were feeling based on the behaviors displayed. Since I prided myself on my knowledge of dog behavior and believed that I possessed a burgeoning professional understanding of dogs’ visual signals, I was embarrassed to admit that I simply did not arrive at the same interpretations upon viewing some of the images. How did we arrive at different conclusions? Was I simply too inexperienced to see what the presenter was seeing, or were her interpretations completely idiosyncratic?

Such questions are at the core of this dissertation. I have explored the role of interspecific experience in interspecific emotion perception by asking humans with varying levels of dog experience to provide judgments of emotion in dogs. In this chapter, I first review previous research on intraspecific emotion perception and the role of experience in its development. Then, I discuss previous research on interspecific emotion perception, followed by the rationale behind my own research. A note on terminology is in order: I use the term “perception” when referring to studies in which judgments of emotion were discussed without regard to whether or not they were “correct” according to an external standard. I use the term “recognition” specifically
Development of Emotion Perception

The ability to perceive and recognize emotion in others is a fundamental human social cognitive skill, facilitating interpersonal interaction, social learning, and empathic behavior (Frith & Frith, 2007; Olsson & Phelps, 2007). Impaired emotion recognition, on the other hand, has been repeatedly associated with psychiatric or developmental disorders, such as schizophrenia and autism (e.g. Edwards, Jackson, & Pattison, 2002; Golarai, Grill-Spector, & Reiss, 2006). For example, autistic individuals have been found to be less accurate than controls at identifying facial expressions of fear, sadness, and disgust (Wallace, Coleman, & Bailey, 2008).

As is true for many behaviors, the development of emotion perception is influenced by nature, nurture, and their interaction. Several studies have found genetic bases for individual differences in facial expression recognition, but such genetic predispositions can be augmented by environmental experiences (McClure, 2000). For example, individuals who are homozygous for the short allele of a polymorphism in the promoter region of the serotonin transporter gene (5-HTTLPR) recognize negative facial expressions at a lower intensity than individuals with other genotypes and display greater activity in the amygdala when viewing fearful faces (Antypa, Cerit, Kruijt, Verhoeven, & Van der Does, 2011; Hariri et al., 2002). However, recent negative life experiences have been found to moderate the effect of the 5-HTTLPR polymorphism (Antypa, et al., 2011). Short-allele homozygotes with negative life experiences were found to be especially sensitive to sad and angry facial expressions. In addition, some have
suggested that children who are genetically predisposed to be highly sensitive to emotional expression might also be more likely to seek social interaction, thereby further expanding their experiences and refining their emotion perception (Lau et al., 2009).

Exposure to emotional stimuli is believed to influence the development of emotional circuits in the brain, such as connections between the amygdala and orbitofrontal cortex (Leppänen, 2011). Some have proposed a sensitive period of development during which such circuits are “experience-expectant” and maturationally prepared to incorporate emotional stimuli from the environment (Greenough, Black, & Wallace, 1987; Leppanen & Nelson, 2009). Under the experience-expectant model, refinement of emotion-related neural circuits results from a universally-experienced, species-typical level of exposure to emotional stimuli. For example, a child’s typical interactions with its mother would be considered part of this model.

The sensitive period of the experience-expectant model is still a highly theoretical construct, though there appears to be some evidence for the existence of such a period in the development of interspecific face perception. For example, six-month-old infants discriminate among faces of individual monkeys or humans, while nine-month-old infants only discriminate among human faces, suggesting a sensitive period during which perceptual narrowing occurs (Pascalis, de Haan, & Nelson, 2002). However, nine-month-old infants who receive exposure to monkey faces retain the ability to discriminate monkey faces (Pascalis, et al., 2005). In addition, when listening to monkey vocalizations, four- and six-month-old infants, but not older infants, display a looking preference for the matching facial expressions (Lewkowicz & Ghazanfar, 2006).

However, the concept of the sensitive period is hypothetical as applied to intraspecific
emotion perception and has not been further specified for interspecific emotion perception.

In addition to the experience-expectant model, some have proposed that experience-dependent processes influence the development of emotion perception (Pollak et al., 2000). Under this model, non-universal and possibly individual-specific exposure to emotional stimuli influence the development of emotion perception. Individual differences in mothering styles would be an example of an experience-dependent contribution to the development of emotion perception and recognition. Experience-dependent processes are not proposed to be limited to a specific period of development (Leppänen, 2011). Lastly, rather than developing in an experience-expectant or dependent manner, it is possible that typical intraspecific emotion perception could develop in an experience-independent manner or even without any exposure to emotional stimuli. Since it is impossible to control children’s exposure to human emotional stimuli, these hypotheses cannot be thoroughly tested.

In the following sections, I will focus on research exploring the development of emotion recognition using human facial expressions. While there is some research on the decoding of emotion using body language and vocal signals, the vast majority of developmental studies on emotion have focused on facial expressions.

**Typical Development of Emotion Recognition**

The developmental course of emotion recognition typically begins at birth and ends in late adolescence. Emotion processing and basic emotion recognition occur first, followed by refinements in accuracy and speed (review: Herba & Phillips, 2004). By 2-3 months of age, infants discriminate among facial expressions (Field, Woodson,

Recognition of positive expressions generally develops earlier than recognition of negative expressions (Camras & Allison, 1985; Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007; Kolb, Wilson, & Taylor, 1992; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000). Studies using varying intensities of expressions have demonstrated that by the age of 5, children have developed nearly adult-like recognition of happy expressions (Gao & Maurer, 2009, 2010). In contrast, the recognition of surprise, disgust and fear continues to develop until the age of 10, while the recognition of anger and sadness remains in development after that age. By early adolescence, children display adult-like emotion recognition, but their brain activity while viewing expressions varies from adult patterns until late adolescence (Batty & Taylor, 2006; Monk et al., 2003).

**Experience-Dependent Development of Emotion Recognition**

Individual or even cultural differences in environmental exposure to others’ emotional expressions may influence the development of emotion perception and recognition. Recent evidence suggests that the characteristics and quantity of exposure to emotional information are associated with individual differences in facial expression recognition. For example, Elfenbein and Ambady (2002, 2003) demonstrated that members of a cultural group are more proficient at recognizing one another’s emotional expressions than those of another cultural group. The size of this in-group advantage is associated with the level of exposure between the cultures of the emotion perceiver and presenter. Interestingly, the in-group advantage exists even when the perceiver and
presenter are of the same race and speak the same language. The authors concluded that there are “emotional dialects” akin to linguistic dialects that are shaped by individuals’ exposure to emotional expressions.

There is also a growing body of research on the effect of negative experiences in the development of emotion perception and recognition. Neglected children experience greater difficulty than control children in discriminating among facial expressions due to a deficit in socioemotional information during development (Pollak, et al., 2000). This difficulty with discriminating expressions is evident in children who have been neglected in either a home or institutional environment. For example, Eastern European children who had received institutionalized care experienced difficulty in recognizing happy, sad, and fearful facial expressions (Pollak & Fries, 2004).

The patterns of emotion recognition have also been demonstrated to vary between abused and neglected children. While neglected children encounter a deficit of emotional information, abused children receive over-exposure to negative emotions, such as anger. Subsequently, abused children become hyper-responsive to angry expressions, tending to categorize more expressions as angry than control children while displaying typical categorization of fearful, happy, and sad facial expressions (Pollak, et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002; M. W. Sullivan, Carpenter, Bennett, & Lewis, 2008). Abused children also develop different perceptual boundaries for the recognition of anger, recognizing angry expressions with less sensory input, at lower intensity levels, and earlier in the expression formation process than non-abused children (Gibb, Coles, & Schofield, 2009; Pollak & Kistler, 2002; Pollak, Messner, Kistler, & Cohn, 2009; Pollak & Sinha, 2002). In addition, even children exposed to a single traumatic event, such as a
terrorist act, develop atypical emotion recognition skills, identifying anger more readily than non-exposed children (Scrimin, Moscardino, Capello, Altoe, & Axia, 2009).

The neural consequences of abuse and neglect are reflected in electrophysiological and brain imaging data involving brain areas related to emotional functioning. Typically, neuroimaging studies show activation in the amygdala and prefrontal regions and connectivity between the two areas during emotion processing in both children and adults (Baird et al., 1999; Phan, Wager, Taylor, & liberzon, 2004). PET scans of the brains of institutionalized children, on the other hand, show reduced connectivity between these areas (Eluvathingal et al., 2006). In addition, institutionalized children display cortical hypoarousal compared to controls while viewing facial stimuli (Moulson, Westerlund, Fox, Zeanah, & Nelson, 2009). While neglect is associated with hypoarousal, abuse is associated with selective hyperarousal. Abused children display increased amplitude of event-related potentials related to attention, but only while viewing angry faces (Pollak, Cicchetti, Klorman, & Brumaghim, 1997; Pollak, Klorman, Thatcher, & Cicchetti, 2001)

Childhood experiences need not be severely aberrant in order to alter emotion recognition. One-year-old infants who were assessed as securely attached to their mothers in the Strange Situation test were found at the ages of 6 and 11 to display higher accuracy in facial expression recognition than children who had been insecurely-attached (Steele, Steele, & Croft, 2008). Furthermore, a twin study of genetic and environmental contributions to the recognition of facial expressions found that variability in the recognition of specific expressions was explained by non-shared environmental effects, which could include exposure to emotional stimuli (Lau, et al., 2009).
Emotion in Animals and the Measurement of Emotion

Before turning to a discussion of recent research on interspecific emotion perception, I will briefly consider definitions of emotion and address the concept of emotion in animals. Emotion theorists differ in their definitions of emotion and approaches to studying emotion (Niedenthal, Krauth-Gruber, & Ric, 2006). For example, some define emotion as feelings which can be self-reported and require some level of consciousness (e.g. Scherer, 1984). Others define emotion based on the production of physiological responses or facial expressions (e.g. Ekman, Friesen, & Ancoli, 1980; James, 1890). Still others define emotion as a set of cognitive phenomena (e.g. Frijda, 1986). While researchers of human emotion have used all of the above approaches, researchers of emotion in animals are limited to approaches that rely on physiological or behavioral measures.

In an effort to avoid the appearance of anthropomorphism, there has been an aversion to discussion of emotion in animals among researchers other than comparative neuroscientists and some evolutionary biologists (de Waal, 2011). Rejection of emotional experience in animals has been considered parsimonious, even though it suggests that humans have developed an original and elaborate system for the production, perception, and processing of emotions in a short evolutionary timespan. There is both behavioral and physiological evidence for the experience of emotion in animals. The morphology of emotional behavior (e.g. freezing during fear) and the situations that elicit emotions (e.g. predators) are similar across species (Parr & Gothard, 2007). In addition, facial expressions in a variety of animals, including dogs, were famously illustrated by Charles Darwin (1872/2009) in *The Expression of the Emotions in Man and Animals*. He
used cross-species morphological similarities in facial displays to argue for the homology and adaptive nature of emotion.

Affective neuroscientists have also argued for the homology of emotion based on similarities across mammalian species in subcortical brain structures and responses to stimulation of these structures (Burgdorf & Panksepp, 2006; Panksepp, 1998, 2003, 2005). For example, the amygdala has been implicated in the production of fearful behavior and the “fight or flight” response in human and nonhuman animals (e.g. Lang, Davis, & Ohman, 2000). fMRI studies show activation of the amygdala in humans experiencing conditioned fear responses (LaBar, Gatenby, Gore, LeDoux, and Phelps, 1998). In studies of fear-conditioned rats, behaviors considered to be indicative of fear, such as freezing and suppression of drinking behavior, are reduced in animals with lesions of the amygdala (e.g. LeDoux et al., 1990). Physiological indicators of fear in rats have also been observed and include the release of glucocorticoids from the adrenal cortex and an increase in arterial pressure (e.g. LeDoux et al., 1990; Rodrigues, LeDoux, & Sapolsky, 2009). In addition, Berridge and colleagues have observed rats’ positive affective responses to food rewards, such as sucrose. The animals’ behavioral responses are similar to the facial expressions made by infants in response to sweet tastes (Steiner, Glaser, Hawilo, & Berridge, 2001). In addition, activation of opioid receptors in the nucleus accumbens of the rats’ brains enhances these positive affective responses to sucrose (e.g. Berridge, 2000). Lastly, other work by Berridge suggests that emotions can be produced in humans without conscious awareness, substantiating the view that animals could experience emotions without necessarily being conscious of what they are feeling (Berridge & Winkielman, 2003).
There appears to be agreement among canid researchers, veterinarians, and other dog professionals on the appearance of some emotional behaviors in dogs. For example, fearful dogs are said to reduce their body size - crouching into a low posture, flattening their ears, and holding their tails in a low position (Bradshaw & Nott, 1995; Fox, 1971). Shaking, yawning, salivation, freezing, panting, paw-lifting, and vocalizing are examples of other behaviors that have been associated with fear in dogs (Beerda, Schilder, van Hooff, de Vries, & Mol, 1999; Beerda, Schilder, van Hooff, de Vries, & Mol, 1998, 2000; Ogata, Kikusui, Takeuchi, & Mori, 2006). Such behaviors are also observed in dogs who have been diagnosed by veterinarians with fear-related disorders (e.g. fireworks phobia) (Landsberg, Hunthausen, & Ackerman, 1997). In fact, psychopharmacology is used to treat such disorders in a similar manner as in humans and with similar success, further supporting the idea that there are parallels between humans and animals in the biology and experience of emotion. Physiological responses by dogs to fear-inducing stimuli, such as loud noises and shock, have also been observed and include increases in heart rate, respiration, salivation, body temperature, and cortisol levels (Beerda, Schilder, van Hooff, & de Vries, 1997; Beerda et al., 1998; Corson, 1971; Hydbring-Sandberg et al., 2004; King, Hemsworth, & Coleman, 2003; Ogata et al., 2006).

The relationship between behavioral and physiological indicators of emotion is not always clear. Some physiological measures can be observed behaviorally. For example, an increase in respiration rate can be observed as panting behavior. However, it is also important to note that physiological and behavioral measures can become disassociated in both dogs and humans, demonstrating the limitations of using only one
type of measure. For example, in a study of fear-conditioning in dogs, some dogs exhibited an increase in heart rate and body temperature, but no obvious behavioral changes (Ogata et al., 2006). A clinical study of thunderstorm-phobic dogs also demonstrated that cortisol levels, a physiological indicator of stress, were not associated with behavioral responses to thunder, such as panting, pacing, vocalization, and trembling (Dreschel & Granger, 2005). Cortisol levels were also not associated with behavioral responses to social and spatial restriction and fear-inducing stimuli in some studies with shelter and laboratory dogs (Beerda et al., 1999; Hennessy et al., 2001). In human studies, individuals who report stronger feelings of emotion and are more facially expressive have been shown to display weaker physiological indicators of emotion (e.g. Buck, 1979). In addition, human social norms can lead to the suppression of emotional expressivity in the face and body (Niedenthal, Krauth-Gruber, & Ric, 2006). There is also the question of which physiological indicator to use. In a study of heart rate, finger temperature, skin conductance, muscle activity, and other physiological measures in humans displaying various facial expressions, there was no single indicator that distinguished among the emotions (Levenson, Ekman, & Friesen, 1990). Thus, reliance on a single indicator or on a single class of indicators (e.g. physiological, behavioral, cognitive) may lead to incomplete interpretations.

In my dissertation research, participants interpret emotion in dogs using behavioral observation. To compare perceptions of emotion among individuals with various levels of dog experience, it is not necessary to determine the dogs’ “true” emotional state. However, to the extent that the interpretations of highly-experienced individuals might be considered more accurate than those of less-experienced individuals,
then the limitations of assessing emotion using only behavioral indicators should be kept in mind when interpreting the results.

**Interspecific Emotion Perception**

One of the difficulties of exploring the role of experience in the development of emotion perception is that one cannot control or accurately measure the quality and quantity of humans’ lifetime exposure to emotional information from other humans. Even abused and neglected individuals have encountered a wide range of emotional expressions, including the expressions of non-abusive family members and other individuals. In contrast, humans with little direct dog experience, other than the occasional encounter with others’ dogs, can be identified. At the least, the range of experience with dogs in the human population is wider than the range of experience with humans. Therefore, investigations of interspecific social cognition may provide a promising, new route for researchers seeking to understand the role of experience in the development of social cognitive skills like emotion perception.

**Human Perception of Emotion in Dog Vocalizations**

Several studies have investigated the role of experience (and age) on humans’ interpretations of dog barks. Pongrácz et al. (2005) found that listeners’ interpretations did not vary according to their experience with dogs. They asked participants to identify the emotional content and context of played-back dog barks. Owners of the breed whose barks were played, owners of other breeds, and non-owners did not differ significantly from each other in categorizing barks by situation, and all experience groups performed above chance level. Furthermore, most participants’ emotion ratings were appropriate for the situations in which the barks occurred. For example, barks elicited by a stranger
approaching the home, as well as barks elicited during schutzhund training (police-dog-type activities), were rated high in aggression, while barks elicited by being left alone were rated as high in despair. In contrast, barks elicited during play or by getting ready for a walk were rated as high in happiness and playfulness.

A similar study was conducted with children between the ages of 6 and 10, as well as adults (Molnár, Pongrácz, Doka, & Miklósi, in preparation). Each age group included dog owners and those who had never owned a dog. There was no significant difference in bark decoding abilities between owners and non-owners. All groups, except for six-year-old non-owners, were able to identify above chance the situation in which the barks were elicited. However, there was an increase in accuracy with age. Ten-year-olds were more accurate than six-year-olds, and adults were more accurate than children of all age groups.

Molnár et al. (2010) also asked individuals with varying visual experience with dogs to interpret dog barks. They compared congenitally blind individuals, blind individuals with previous visual experience, and sighted individuals. Again, experience did not play a role in most responses. All groups successfully identified the context of the barks above chance level, and there were no significant differences among the groups. In most cases, ratings of the barks’ emotionality also did not vary by experience.

All in all, these studies suggest that the development of interspecific emotion perception using auditory signals could develop universally from a baseline level of exposure to dog or other animal vocalizations. There was a significant effect for age, whereby bark decoding abilities increased across childhood, regardless of the level of experience with dogs, suggesting that minimal interspecific experience may be required
for the development of these abilities. Morton (1977) had posited that animals’ motivational and affective states are associated with basic acoustic qualities of their vocalizations (e.g. tonality, frequency). For example, atonal, low-pitched vocalizations have been associated with aggression in a variety of species. The acquisition and application of these simple rules would enable the development of auditory interspecific emotion perception without substantial interspecific experience.

There were no strong individual differences in auditory emotion perception based on participants’ level of experience with dogs, arguing against experience-dependent development. In general, neither visual experience, nor experience with dogs, was a prerequisite for successful classification and rating of dog barks. However, experience with dogs did play a role in the youngest age group tested. Six-year-olds with a dog performed above chance, while those without a dog did not, suggesting a temporary period of increased sensitivity to experience after which a universal-level of exposure to dog or other animal vocalizations equalizes individual differences.

**Human Perception of Emotion in Dog Visual Signals**

While the ability to interpret dog barks appears to develop from a universally-experienced level of interspecific exposure, the ability to interpret the visual signals of dogs may also be vulnerable to experience-dependent processes. Meints, Racca, and Hickey (2010) asked 4-6 year-old children and adults to categorize neutral, aggressive, and happy facial expressions of dogs and humans. Accuracy increased with age: 69% of four-year-olds misidentified aggressive dog faces as smiling and happy, while the error rate was 35% in five-year-olds and 25% in six-year-olds. In contrast to their recognition of canine facial expressions, the children were correct for more than 90% of the human
expressions. In contrast, adults made errors on fewer than 1% of both the human and dog expressions. Using eye-tracking technology, children’s viewing patterns were also investigated (Meints, Allen, & Watson, 2010). While children scanned the eye, nose and mouth of human expressions, as well as non-aggressive dog expressions, they focused on the mouth in aggressive dog faces.

In a similar study, children aged 4-10 years old and college students were presented with short videos of dogs and asked to categorize them by the emotion displayed (Lakestani, 2007; Lakestani, Donaldson, Verga, & Waran, 2006). The emotional assessments of a panel of behavior professionals, composed of three pet behavior consultants and four veterinary behaviorists, were considered the correct responses. Performance tended to increase with age with 4-year-olds producing more errors than children aged 6, 8, and 10. All age groups performed above chance level, except for 4-year-olds on the videos of fearful dogs. The authors also compared dog owners with non-owners within each age group and found that among adults, dog owners performed significantly better than non-owners. Lastly, the authors asked participants to explain how they determined the dogs’ emotions. Younger children were more likely to report looking at the face when interpreting the behavior of fearful and friendly dogs, while older individuals were more likely to observe the tail, ears, and posture. Younger children also seemed to focus on single, rather than multiple, features of the dog when determining its emotional state.

Tami and Gallagher (2009) investigated the relationship between dog experience and interpretations of behavior in videos of dog-dog interactions. Two pet behavior consultants pre-screened the videos and selected descriptors for the focal dogs’ behavior.
The descriptors included terms describing emotional and motivational states, such as “fearful,” “confident,” “friendly,” “aggressive” and “playful.” The consultants’ descriptors were considered accurate and were compared to participants’ responses. Participants included individuals with a variety of dog experience: veterinarians, dog trainers, dog owners, and non-owners. Generally, there was no significant difference among the experience groups in their ability to correctly label the behavior of the focal dog. However, non-owners were less accurate in identifying confidence than trainers and less accurate in identifying play solicitation than all other experience groups.

Overall, the studies on humans’ interpretations of emotion using dogs’ visual signals suggested a strong effect of age, akin to the studies showing effects of age on emotion recognition in human facial expressions and dog vocalizations. A baseline level of exposure to inter- and intra-specific emotional information throughout childhood may refine the neural networks involved in emotion processing. Younger children produced more errors and focused on the “smiling” mouth in aggressive dog faces or on the face alone, rather than multiple body parts. However, there was also evidence for experience-dependent development. Among adults, owners and individuals with professional dog experience provided more accurate interpretations on some measures than non-owners, suggesting that individual differences in the level of interaction with dogs could influence the development of interspecific emotion perception using visual signals.

**Dissertation Research**

The studies reviewed above provide evidence that interspecific emotion perception can develop with minimal interspecific experience, while there was less evidence for experience-dependent development. Age was generally more influential
than experience with dogs in producing accurate interpretations. However, the role of experience has not been thoroughly explored, especially for interpretations of dogs’ visual signals. While Tami and Gallagher (2009) did compare the interpretations of several experience groups (veterinarians, trainers, owners, non-owners), they asked participants to decode the behavior of dogs during dog-dog interactions, which can be difficult to interpret, even for some dog professionals.

It is apparent that there are both conceptual (e.g. developmental models) and methodological (e.g. choice of stimuli) issues raised by the literature that currently limit our understanding of emotion perception in general and in particular, interspecific emotion perception. Further interspecific research is needed. As previously mentioned, studies on the experience-dependent development of human facial expression recognition are limited by the fact that all humans are highly exposed to the facial expressions of other humans. While studies of atypical experiences, such as abuse and neglect, are extremely informative, there is a greater range of interspecific experience that can be utilized for investigations of the role of experience in the development of emotion perception. Moreover, interpretations of dogs’ affective and motivational states by humans are increasingly relevant in both academic and practical contexts. Shelters, for example, routinely make euthanasia decisions based on evaluations of dog behavior (Bollen & Horowitz, 2008). In addition, misinterpretations of dogs’ signals, especially by young children, have been suggested to be a prominent cause of dog bites (Overall & Love, 2001). Interpretations of dog behavior are also common in the growing number of studies on dog cognition and behavior, as well as clinical veterinary studies and behavior genetics studies (e.g. Cottam & Dodman, 2009; Kubinyi et al., in preparation; Vas, Topál,
Gácsi, Miklósi, & Csányi, 2005). Thus, if experience can be shown to be influential in interspecific emotion perception, there are real-world implications. Interpreters of behavior - whether non-dog-owners, owners, behavior professionals, or researchers - may need to evaluate their level of experience with dogs and consider how it might influence their judgments.

To ascertain the role of experience in visual interspecific emotion perception, I asked adults with various levels of dog experience to interpret the emotional states of dogs depicted in videos. Videos of dogs outside of the context of dog-dog interactions were utilized, thus addressing the limitations of Tami and Gallagher (2009). Participants provided emotion ratings and categorizations, as well as details of how they arrived at their interpretations. If only a baseline level of exposure to dogs is necessary for the development of interspecific emotion perception, then there should not be significant differences among individuals with different levels of experience with dogs. If, on the other hand, interspecific emotion perception develops in an experience-dependent manner, then the experience groups should differ in their interpretations.

My hypothesis, based on the review of previous literature, is that humans’ level of experience with dogs will be associated with their interpretations of emotion in dogs’ visual signals, supporting the idea that emotion perception can develop in an experience-dependent manner. Moreover, based on findings reviewed above demonstrating that positive emotional expressions are identified earlier and with greater accuracy than negative emotional expressions, I predict that the largest effects of experience will be found in interpretations of emotional displays that have been judged as negative by behavioral experts. Lastly, based on previous interspecific research showing that
differences in emotion perception have been associated with viewing patterns, I predict that experience will be associated with participants’ observational focus when interpreting dogs’ emotions (e.g. body parts observed).
CHAPTER 2

METHODOLOGY

Overview of Methodology

To explore whether interspecific emotion perception develops in an experience-dependent manner, individuals with various levels of dog experience were asked to provide their interpretations of emotion in dogs. First, a set of videos depicting dogs was assembled and evaluated by expert raters. A subset of the videos was subsequently included in a web survey made available to the general public. The web survey included questions about participants’ demographics and experience with dogs, as well as their interpretations of emotion in the dogs depicted in the videos. All procedures were conducted with approval from the Columbia University IRB and IACUC (Protocol #AAAE7861 and #AAAB7022).

Stimuli Development

One of the challenges of studies of emotion perception is the selection of appropriate stimuli. Over the years, researchers of human facial expression recognition have developed standardized stimuli databases. Ekman and Friesen’s Pictures of Facial Affect, for example, are perhaps the most well-known set of facial stimuli (Ekman & Friesen, 1976). However, to my knowledge, standardized sets of stimuli are not available for studies of interspecific emotion perception. Therefore, stimulus development was my first undertaking. The goal was to develop a set of short dog video clips (<1 min. each) that depicted a range of emotional experiences, as determined by an expert panel of dog behavior professionals. Eight professionals with a mean of 20 years
of experience were selected to provide their interpretations of the behavior in the videos. All of the professionals had received certifications from professional organizations. Two were diplomates of the American College of Veterinary Behaviorists (DACVB), two were certified applied animal behaviorists (CAAB), two were certified pet dog trainers (CPDT-KA), and two had received certifications from other professional organizations. They were presented with an online survey that included a total of 30 videos (see Table 2-1), which had been created by myself, professional videographers, dog behavior professionals, and acquaintances. The videos depicted dogs of various breeds and ages in a variety of everyday situations and did not include sound due to my focus on the interpretation of visual signals. When selecting the 30 videos for expert evaluation, several factors were considered, including the quality of the video, breed and behavioral diversity, and situation diversity. For example, videos that were very dark or that did not clearly display the dog were excluded. In addition, no more than three videos of a single breed were included, and a variety of behaviors were depicted (e.g. running, walking, lying down, tail-wagging, tucked tail, yawning, lip-licking, paw-lifting, panting; see Table 2-1 for examples). Furthermore, a variety of situations were included (e.g. indoors, outdoors, with and without people).

The expert panel completed a series of nine-point bipolar rating scales about the dog in each video (safe/unsafe, positive/negative, relaxed/stressed, loose/tense, calm/excited, bold/fearful, unhappy/happy, peaceful/angry, and cheerful/sad). The midpoint of each scale was designated “neutral.” They also selected a single emotion category for each dog (happy, sad, fearful, angry, neutral) and provided a description of the behaviors that helped them determine how each dog was feeling (Table 2-1).
Table 2-1. Brief description of each video and examples of experts’ descriptions of behaviors used to interpret the dogs’ emotions.

<table>
<thead>
<tr>
<th>Video</th>
<th>Brief Description</th>
<th>Expert Description of Specific Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Golden Retriever rolls on back in grass, looks around, and walks away</td>
<td>Rolling calmly, loose tail wag, ears gently back, looking around with open mouth and relaxed commissures (corners of mouth), trots away with tail up and gentle wag</td>
</tr>
<tr>
<td>2</td>
<td>Border Collie sniffs ground, then approaches and greets woman</td>
<td>Gentle tail wag, increasing during interaction; play bow; gentle jump onto person; relaxed eye contact; responsive to action of person; exploring environment without tensing muscles</td>
</tr>
<tr>
<td>3</td>
<td>Irish Setter stands on hind legs while licking man’s face.</td>
<td>Gentle mid-position tail wag, relaxed musculature, steady licking without turning away, not frenetic licking, responsive to handler’s movement</td>
</tr>
<tr>
<td>4</td>
<td>Dalmatian is standing outside, looking around and at camera.</td>
<td>Direct gaze, looks away and looks back calmly; gentle mid-position tail wag; relaxed muscles on body and face; pupils normal; lips loose and in gentle upward curve</td>
</tr>
<tr>
<td>5</td>
<td>Large mixed-breed is sitting indoors and looks at camera from across the room.</td>
<td>Very stiff, eyes wide open, ears forward, forehead wrinkled, mouth tight</td>
</tr>
<tr>
<td>6</td>
<td>Woman is standing and holding Border Collie and squats to put the dog back down on the ground.</td>
<td>Squirming, stiff, licking lips, can see whites of eyes, facing away from person, attempts to escape once on ground</td>
</tr>
<tr>
<td>7</td>
<td>Medium mixed-breed barks at camera while moving from side to side.</td>
<td>Stiff tail wagging, barking, jumping forward then back, hiding behind person, holding ears and body back, slightly lowered tail while wagging in circular manner, not maintaining gaze</td>
</tr>
<tr>
<td>8</td>
<td>Shepherd mix runs towards fence, jumps up on fence and returns to standing position while barking.</td>
<td>Quick movement, barking, direct gaze, ears primarily back and tense, forward posture, stiff wagging tail, furrowed brow</td>
</tr>
<tr>
<td>9</td>
<td>Maltese runs in the snow alongside a woman, moving towards the camera.</td>
<td>Running forward with upward bounce, tail up and loose, looking directly back at person with open mouth and brief eye contact, relaxed ears</td>
</tr>
<tr>
<td>10</td>
<td>Maltese walks around two people near a door and briefly jumps up on one of them. Woman pets dog.</td>
<td>Jumping up in a relaxed way; prancing around, face relaxed and loose; not avoiding petting; relaxed, high, flexible tail wag, voluntary climb onto person with muscles loose</td>
</tr>
<tr>
<td>11</td>
<td>Doberman is sitting outside looking at camera, then barks, backs up, and runs away.</td>
<td>Licking lips; quick head turns; panting; ears forward; wide eyes; barks were short and aimed upwards; a lot of bounce to the body when running away; gaze direct but not fixed</td>
</tr>
<tr>
<td>12</td>
<td>Shepherd mix stands just outside a screen door, looking towards the camera.</td>
<td>Low and fast tail wag, tense areas around dog's eyes and muzzle, heavy panting, head turns away from camera, ears pressed back, weight slightly shifted to back end, huge tongue, eyes bulging</td>
</tr>
<tr>
<td>13</td>
<td>Dalmatian is lying on the floor with head in woman’s lap. Dog looks up at woman, then at camera, and back at woman.</td>
<td>Tongue flick, ears back, mouth closed, moved head to establish eye contact, muscles on body appear relaxed, voluntary movement onto back with partial forepaw lift, legs bent loosely</td>
</tr>
<tr>
<td>14</td>
<td>Pit bull mix (puppy) is standing in a small room, then approaches and jumps up towards the camera.</td>
<td>Tongue flick at start, ears are back, whole back end is wagging, loose gait, brow a little furrowed, eyes wide, mouth shut tight</td>
</tr>
<tr>
<td>15</td>
<td>Collie is lying on couch while person pets him.</td>
<td>Licking lips, closed mouth, not looking at person, neck stiff, closing eyes towards end</td>
</tr>
<tr>
<td>16</td>
<td>Girl is sitting on the ground while hugging a small dog.</td>
<td>Panting, not looking at child, stiff limbs, lack of movement in body, slight tail wag, mouth open, ears back, blinking eyes, leaning towards child</td>
</tr>
</tbody>
</table>
As a measure of interrater agreement, the intraclass correlation coefficient (ICC) in a two-way mixed model with absolute agreement and single-measure reliability was calculated on scale ratings for each video (Wan & Champagne, 2011). A wide range of agreement was obtained (ICC = -.05 to .83). High agreement among the experts (ICC > .6) was obtained in ratings for 12 of 30 videos (40%), moderate agreement (.4 ≤ ICC ≤ .6) for 6 videos (20%), and low agreement (ICC < .4) for 12 videos (40%). The ICC for each video indicates the proportion of the variance in the ratings explained by differences among the rated items, rather than differences among the raters. An ICC of 1.0 would indicate that all raters provided the same ratings for all items. Though my emphasis was on retaining videos rated with high agreement, low-agreement videos were also of interest, because they could contain more subtle or difficult-to-interpret behaviors, interpretations of which could be particularly susceptible to the effects of experience. It should be noted that a low ICC does not necessarily suggest a wider range of ratings than a high ICC, but simply that there is less absolute agreement in the ratings.

Ten videos that had been rated with high agreement (ICC = .63 to .83) and six videos that had been rated with low agreement (ICC = .08 to .39) were selected for inclusion in the public survey. Descriptions of each video are contained in Table 2-1. The sixteen videos were grouped into eight pairs (Videos 1-2, 3-4, etc.), five high-agreement pairs and three low-agreement pairs. Each pair contained videos with similar expert ratings, and each participant received one video from each pair (see also Measure).

For analyses in subsequent chapters, videos were arranged into groups by valence and agreement based on the experts’ ratings. Videos receiving mean ratings over 5 on the negative/positive item were considered positive-valence videos, while videos with mean
ratings below 5 were considered negative-valence videos. Positive-valence videos also tended to receive mean ratings at the “positive” ends of the other rating scales (e.g. safe, happy, relaxed), while the reverse was true for negative-valence videos. **Table 2-2** presents mean ratings and interrater agreement among the experts for the videos in each grouping. **Figures 2-1 to 2-4** also depict mean ratings.

Inspection of the experts’ ratings of the low-agreement videos suggested that the emotional content of these videos could be considered, for the most part, weakly-valenced. Raw ratings did not tend to be clustered at the low and high ends of the scales, indicating that the lack of agreement was not due to differences in opinion on strongly-valenced behavior. Instead, ratings tended to be distributed around the means, which were often in the mid-range of the scales. In addition, the mean ratings for the low-agreement videos followed similar patterns as their similarly-valenced, high-agreement counterparts. The “shapes” of the curves in **Figures 2-3 and 2-4** appear to be less-pronounced versions of the patterns in **Figures 2-1 and 2-2**, indicating that low agreement was not simply due to a lack of emotional content. Rather, the maintenance of structure in the data suggests that the emotional content of the low-agreement videos was a weak version of that in the high-agreement videos.

Expert categorizations of the high-agreement videos tended to be aligned with expert ratings and are compared with respondents’ categorizations in **Chapter 5**. For example, “happy” was the most common categorization for the videos that had been assigned to the high-agreement, positive-valence set based on ratings. For five of six of
Table 2-2. Mean ratings and intraclass correlation coefficients (interrater agreement) for videos in each video grouping. Rating scales were bipolar (1 = left term and 9 = right term).
Figure 2-1. Mean expert ratings on emotion rating scales for high-agreement, negative-valence videos. Arousal scale (calm/excited) omitted in this and subsequent figures to focus on emotional structure of data. Error bars omitted for clarity.

Figure 2-2. Mean expert ratings on emotion rating scales for high-agreement, positive-valence videos.
Figure 2-3. Mean expert ratings on emotion rating scales for low-agreement, negative-valence videos. The basic pattern in Figure 2-1 is repeated here in a less-pronounced version.

Figure 2-4. Mean expert ratings on emotion rating scales for low-agreement, positive-valence videos. The basic pattern in Figure 2-2 is repeated here in a less-pronounced version.
these videos, all eight experts selected the “happy” category. The sixth video was
categorized as happy by half of the experts and neutral by the other half. In addition,
“fearful” was the most common categorization for videos that had been assigned to the
high-agreement, negative-valence set. All experts selected “fearful” for two of the four
videos, and for the other two, at least five of eight experts selected “fearful.”

**Subject Recruitment**

A recruitment website (dogbehaviorstudy.org) was created that briefly described
the research and contained a link to the survey, which could be completed and submitted
online. The URL was included in all recruitment materials. Participants were recruited
through a variety of means, including personal contacts, online postings, e-mails, press
releases, flyer distribution at dog events, appearance on a local pet television show, and
the psychology department’s participant pool. An effort was made to encourage non-
dog-owners to participate through postings on non-dog-related websites and through
flyers at neutral locations, such as the post office, library, and bank. In addition,
participants were encouraged to share a link to the recruitment website with friends and
family on social networking websites, such as Facebook and Twitter. Google Analytics
was used on the recruitment website to actively monitor the source of traffic to the site
and determine the effectiveness of various recruitment efforts.

**Survey Structure**

The full survey is included in Appendix A. Items that were considered most
relevant to the current research are detailed below. The survey consisted of four main

Section 1: About You

The survey began with a consent form. After consenting to participate in the research, respondents provided demographic information about themselves. It was unlikely that respondents would complete the survey twice due to its length (about 30 minutes). However, respondents were asked for their first and last names so that duplicate submissions could be detected.

After providing demographic information, participants were asked to select “true” or “false” in response to six statements about common dog behaviors, such as “When a dog wags its tail, I know it wants to be friendly.” These items were adapted from statements originally written by Suzanne Hetts, a certified applied animal behaviorist, and were included to explore associations between dog behavior knowledge and experience with dogs. In Chapter 3, the six items are collectively referred to as a “short assessment of dog behavior knowledge.”

Section 2: About Your Dog

Participants who owned dogs at the time of participation were asked to provide demographic information about their dogs, as well as basic information about their relationship with their dogs, such as how many hours they spent with their dogs on the average weekday. Owners who lived with multiple dogs at the time of participation were asked to profile the dog they had lived with for the longest period of time.

Section 3: About Your Experience with Dogs
Respondents were asked to provide information about their experience with dogs. For example, they could indicate whether they had ever owned a dog or whether they had ever worked with dogs professionally. In addition, if they had worked with dogs professionally, they were asked to provide the number of years of professional work, as well as the type of professional work (e.g. dog behavior professional, dog walker, dog groomer).

All respondents also indicated the average number of dogs they currently interacted with on a daily basis and the total number of dogs they had owned in adulthood. Finally, participants rated their own ability to use visual cues to interpret the emotional states of dogs, and they indicated how they had learned to interpret such cues.

**Section 4: Interpretations of Emotion**

Each participant viewed one video from each of the eight pairs of videos previously described. The order of the eight pairs was randomized, as well as the particular video that respondents received from each pair. After each video, respondents were asked for their interpretations of the dog’s emotional state.

First, they were asked to categorize the emotion displayed by the dog in a forced-choice question (angry, fearful, happy, neutral, sad). In intraspecific emotion perception research, the most common emotions studied, often called primary emotions, are anger, fear, happiness, sadness, disgust, and surprise (Elfenbein & Ambady, 2002). The first four emotions were selected for inclusion in the survey due to neurobehavioral evidence supporting the existence of similar affective states in animals, as well as research demonstrating that more than 60% of dog owners perceive these emotions in their dogs (McConnell, 2005; Morris, Doe, and Godsell, 2008; Panksepp, 2005). The order of the
emotion categories was randomized. After selecting an emotion category, participants rated each dog on nine-point bipolar rating scales (safe/unsafe, calm/excited, loose/tense, positive/negative, happy/unhappy, sad/cheerful, angry/peaceful, fearful/bold). The left/right location of the terms at the ends of the rating scales was randomized.

Respondents then indicated which types of behavior helped them interpret how the dog was feeling (facial expression, head position, head movement, body position, body movement). In addition, they indicated which specific body parts were informative (eyes, ears, mouth/tongue, legs/paws, tail). Multiple selections were permitted.

Participants were then presented with an open-ended question, which asked them to explain the specific behaviors that helped them interpret how each dog was feeling. Lastly, they rated how difficult it was to interpret how the dog was feeling and how accurate they believed their judgments were. [Text analysis with the Linguistic Inquiry and Word Count program was used to examine open-ended responses (Pennebaker, Mehl, & Niederhoffer, 2003; Tausczik & Pennebaker, 2010), and the methodology and results are described in Appendix B. Analyses of difficulty and accuracy ratings are included in Appendix C.]

Section 5: Likelihood Ratings

After completing the Interpretations section, the final question of the survey asked respondents to rate on a nine-point scale how likely or unlikely it is that dogs experience each of the following emotions: happiness, anger, sadness, fear, guilt, surprise, love, frustration, excitement, and disgust.
CHAPTER 3

SAMPLE CHARACTERISTICS AND INTERSPECIFIC EXPERIENCE

Overview

This chapter provides background information about the participating sample. It explores their self-reported experience with dogs, as well as their demographic and other characteristics. The sample is divided into experience groups, and the background variables are then compared among the groups. In addition, the level of dog behavior education and knowledge is compared. More-experienced respondents were expected to possess greater knowledge and to have received more education about dog body language. Ratings of the likeliness that dogs experience various emotions are also compared by experience and will be used in further analyses in Chapter 5.

General Sample Characteristics

2,163 participants completed the survey and were included in the analyses that follow. Additional participants began, but did not complete the survey. Of the included participants, 82% were female, and 18% were male. The age of the participants ranged from 18 to 84 with a mean age of 41.44 (SD = 15.06). 91% resided in the United States, while 9% resided in other countries. A total of 30 countries were represented in the sample, such as Australia, Brazil, Canada, Israel, Kuwait, Malaysia, Norway, Slovenia, and the United Kingdom. 17% reported living in rural areas, 56% in suburban areas, and 27% in urban areas.

Experience with Dogs
7% of the respondents had never owned a dog and reported having no experience with dogs or only occasional experience (Low-Experience group). 68% reported having a dog at some point in their lives, but had not worked professionally with dogs (Owners group). 14% had worked professionally with dogs for less than ten years (Prof<10 group), while 11% had worked professionally with dogs for ten or more years (Prof10+ group). Only six individuals from the professional groups reported that they had never owned a dog. Among the professionals, 70% were dog behavior professionals, such as trainers and behaviorists, while 30% worked in fields not primarily associated with behavior, such as grooming, sitting, and non-behavioral veterinary care.

Since the goal of the dissertation is to identify how experience with dogs is associated with the perception of emotion in dogs, the experience groups mentioned above (Low-Experience, Owners, Prof<10, Prof10+) are used in analyses in subsequent chapters. These categories most efficiently summarize individuals’ lifetime experience with dogs. The professionals have been divided into two groups in order to distinguish the most experienced professionals from those who entered the field more recently or who worked in the field temporarily.

Across the sample as a whole, the number of dogs interacted with daily ranged from 0 to 100, the maximum number allowed in the survey, with a mean of 4.36 (SD = 6.96). The number of dogs owned as an adult ranged from 0 to 100, the maximum allowed, with a mean of 5.56 (SD = 9.07).

**Dog Behavior Education and Knowledge**

71% of respondents reported that they had learned “to interpret the body language of dogs,” while 29% reported that they had not. Respondents indicated which, if any, of
four methods (book/article, behavior professional, video, lecture) they had used to learn about this topic. On average, they used 1.87 methods ($SD = 1.54$). Among those indicating such learning, 89% had read a book or article, 68% had received an explanation from a behavior professional, 62% had watched a video, and 46% had attended a lecture or seminar.

Participants’ scores on the short assessment of dog behavior knowledge ranged from 0 to 6, the maximum possible score, with an average score of 4.19 ($SD = 1.71$). In addition, participants’ own assessments of their “dog-reading” ability were high. On a scale ranging from 1 (completely disagree) to 9 (completely agree), most participants agreed with the statement “I am good at figuring out how a dog is feeling by watching what s/he is doing” ($M = 7.08$, $SD = 1.66$).

**Dog-Keeping Practices**

1,184 respondents reported being dog owners at the time of participation. 92% kept their dogs indoors during the day, while 8% kept their dogs outdoors. 71% of the dogs slept in their owners’ bedrooms at night, 28% slept indoors in another location, and 2% slept outdoors. Dog-owning participants reported spending an average of 7.87 hours ($SD = 5.11$) with their dogs on weekdays, not including the time that they spent sleeping.

78% of the respondents reported that their dogs had received some formal training, while 22% did not. Dogs received training for up to nine activities with a mean of 1.52 ($SD = 1.53$). The types of activities for which dogs were trained included basic obedience, competitive obedience, conformation (breed shows), agility, search and rescue, tracking, and herding, among others.
Likelihood of Various Emotions in Dogs

When participants were asked to rate the likelihood that dogs experience each of a list of emotions, the full range of rating choices was used for all of the listed emotions (1 = very unlikely, 9 = very likely). Participants believed that dogs were most likely to experience happiness ($M = 8.26$, $SD = 1.81$), fear ($M = 8.44$, $SD = 1.77$), and excitement ($M = 8.53$, $SD = 1.66$). Participants also believed that dogs experience anger ($M = 6.99$, $SD = 2.65$), sadness ($M = 7.55$, $SD = 2.23$), surprise ($M = 7.87$, $SD = 2.05$), love ($M = 7.31$, $SD = 2.35$), and frustration ($M = 7.56$, $SD = 2.29$), though less so than the aforementioned emotions. Disgust ($M = 4.19$, $SD = 2.82$) and guilt ($M = 4.54$, $SD = 2.93$) received the lowest likelihood ratings.

Characteristics of Experience Groups

The background variables outlined above for the entire sample are discussed for each experience group below and listed in Tables 3-1 and 3-2.

Table 3-1. Demographic characteristics, interactions with dogs, and dog behavior knowledge of each experience group

<table>
<thead>
<tr>
<th>Participant characteristics and knowledge</th>
<th>Low-Exp (n = 152)</th>
<th>Owners (n = 1462)</th>
<th>Prof&lt;10 (n = 307)</th>
<th>Prof10+ (n = 242)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (M ± SD)</td>
<td>23.04 ± 8.43</td>
<td>42.69 ± 14.95</td>
<td>39.13 ± 13.57</td>
<td>48.40 ± 11.02</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>106 (69.7)</td>
<td>1159 (79.3)</td>
<td>280 (91.2)</td>
<td>232 (95.9)</td>
</tr>
<tr>
<td>USA, n (%)</td>
<td>139 (91.4)</td>
<td>1350 (92.3)</td>
<td>263 (85.7)</td>
<td>223 (92.1)</td>
</tr>
<tr>
<td>Setting, n (%)</td>
<td>Rural 2 (1.3)</td>
<td>221 (15.1)</td>
<td>73 (23.8)</td>
<td>78 (32.2)</td>
</tr>
<tr>
<td></td>
<td>Suburban 66 (43.4)</td>
<td>854 (58.4)</td>
<td>159 (51.8)</td>
<td>128 (52.9)</td>
</tr>
<tr>
<td></td>
<td>Urban 84 (55.3)</td>
<td>387 (26.5)</td>
<td>75 (24.4)</td>
<td>36 (14.9)</td>
</tr>
<tr>
<td>Dogs owned as adult (M ± SD)</td>
<td>0.00 ± 0.00</td>
<td>4.61 ± 6.58</td>
<td>6.33 ± 9.01</td>
<td>13.82 ± 16.69</td>
</tr>
<tr>
<td>Dogs interacted with daily (M ± SD)</td>
<td>.23 ± .57</td>
<td>2.74 ± 3.20</td>
<td>9.27 ± 11.47</td>
<td>10.50 ± 10.50</td>
</tr>
<tr>
<td>Dog behavior knowledge assessment score (M ± SD)</td>
<td>2.26 ± 1.10</td>
<td>3.95 ± 1.68</td>
<td>5.35 ± 1.10</td>
<td>5.44 ± .88</td>
</tr>
<tr>
<td>&quot;Good at figuring out how a dog is feeling&quot; (M ± SD)</td>
<td>4.52 ± 1.99</td>
<td>7.06 ± 1.49</td>
<td>7.68 ± 1.26</td>
<td>8.06 ± 1.09</td>
</tr>
<tr>
<td>&quot;Learned to interpret the body language of dogs,&quot; n (%)</td>
<td>18 (11.8)</td>
<td>1003 (68.6)</td>
<td>287 (93.5)</td>
<td>225 (93.0)</td>
</tr>
<tr>
<td>Methods used to learn about dog body language (M ± SD)</td>
<td>.16 ± .46</td>
<td>1.61 ± 1.40</td>
<td>3.05 ± 1.24</td>
<td>3.07 ± 1.30</td>
</tr>
</tbody>
</table>
Table 3-2. Dog-keeping practices by experience group.

<table>
<thead>
<tr>
<th>Dog-keeping practices</th>
<th>Owners (n = 1290)</th>
<th>Prof&lt;10 (n = 290)</th>
<th>Prof10+ (n = 234)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoors during the day, n (%)</td>
<td>1185 (91.9)</td>
<td>274 (94.5)</td>
<td>214 (91.5)</td>
</tr>
<tr>
<td>Sleeps in owner's bedroom, n (%)</td>
<td>896 (69.5)</td>
<td>214 (73.8)</td>
<td>173 (73.9)</td>
</tr>
<tr>
<td>Hours spent with owner daily (M ± SD)</td>
<td>7.65 ± 5.16</td>
<td>7.93 ± 4.66</td>
<td>8.95 ± 5.19</td>
</tr>
<tr>
<td>Formally trained, n (%)</td>
<td>892 (69.1)</td>
<td>245 (84.5)</td>
<td>211 (90.2)</td>
</tr>
<tr>
<td>Number of activities trained for (M ± SD)</td>
<td>1.19 ± 1.26</td>
<td>1.98 ± 1.69</td>
<td>2.80 ± 1.86</td>
</tr>
</tbody>
</table>

**Demographic Variables by Experience Group**

There was a strong female bias across the experience groups, \(X^2(3, N = 2163) = 72.45, P < 0.001\). In addition, the sex bias became larger with experience. For example, while 70% of the Low-Experience group consisted of females, the percentage increased to 96% in the Prof10+ group. The experience groups also differed in age, \(F(3, 2159) = 114.23, P < .001\). The Low-Experience group was the youngest \((M = 23.04, SD = 8.43)\), while the Prof10+ group was the oldest \((M = 48.40, SD = 11.02)\). Most respondents resided in the United States, regardless of experience level. The percentage from the United States ranged from 86% in the Prof<10 group to 92% in the Owners group.

**Other Experience Variables by Experience Group**

The mean number of dogs owned as an adult varied by experience with more-experienced groups reporting greater dog ownership, \(F(3, 2159) = 105.27, P < .001\). While the Low-Experience group had not owned any dogs, the Prof10+ Group had owned 13.82 dogs on average \((SD = 16.69)\).

The mean number of dogs interacted with daily also varied by experience with more-experienced individuals interacting with more dogs, \(F(3, 2159) = 202.06, P < .001\). The Low-Experience group interacted with less than one dog per day \((M = .23, SD = .57)\). Since these individuals had never owned a dog, these interactions most likely
involved casual encounters with neighbors’ or friends’ dogs. In contrast, the Prof10+ group interacted with an average of 10.50 dogs (SD = 10.50) per day.

**Dog Behavior Education and Knowledge by Experience Group**

Scores on the short assessment of dog behavior knowledge varied by experience, with the more experienced groups receiving higher scores, $F(3, 2159) = 213.42, P < .001$. Of a maximum score of 6, mean scores ranged from 2.26 (SD = 1.10) in the Low-Experience group to 5.44 (SD = .88) in the Prof10+ group.

Participants’ agreement with the statement “I am good at figuring out how a dog is feeling by watching what s/he is doing” also varied by experience, $F(3, 2159) = 209.28, P < .001$. On a nine-point scale (1 = completely disagree, 9 = completely agree), mean ratings ranged from 4.52 (SD = 1.99) in the Low-Experience group to 8.06 (SD = 1.09) in the Prof10+ group.

The experience groups also varied in the percentage of respondents who reported that they had learned “to interpret the body language of dogs,” $X^2(3, N = 2163) = 393.54, P < 0.001$. 12% in the Low-Experience group reported such learning, compared to about 93% in each of the professional groups. More experienced individuals utilized more methods (e.g. book, video) to learn about this topic, $F(3, 2159) = 251.66, P < .001$. The average number of learning methods ranged from .16 (SD = .46) in the Low-Experience group to 3.07 (SD = 1.30) in the Prof10+ group.

**Dog-Keeping Practices by Experience Group**

Among respondents who reported owning a dog at the time of participation, there were no significant differences by experience group in the location of their dogs during the day or at night, $X^2(2, N = 1814) = 2.50, P = .29$ and $X^2(2, N = 1814) = 3.49, P = .18$. 
However, the more experienced groups reported spending more time with their dogs, $F(2, 1811) = 6.57, P = .001$. The duration ranged from 7.65 hours ($SD = 5.16$) in the Owners group to 8.96 hours ($SD = 5.19$) in the Prof10+ group.

The percentage of respondents reporting that their dogs had received formal training was higher in the more-experienced groups and ranged from 69% in the Owners group to 90% in the Prof10+ group, $X^2(2, N = 1814) = 64.57, P < 0.001$. The average number of activities for which dogs received training also increased with experience and ranged from 1.19 ($SD = 1.26$) in the Owners group to 2.80 ($SD = 1.86$) in the Prof10+ group, $F(2, 1811) = 144.26, P < .001$.

**Likelihood of Various Emotions in Dogs by Experience Group**

**Emotions included in video interpretations.** There were no significant differences among the experience groups in their ratings of the likeliness that dogs experience happiness, $F(3, 2159) = 2.22, P = .08$. However, ratings of the likeliness of anger, fear, and sadness varied by experience, $F(3, 2159) = 5.40, P = .001$; $F(3, 2159) = 3.02, P = .03$; and $F(3, 2159) = 4.20, P = .006$. Ratings of the likeliness of fear increased with experience; the Low-Experience group provided the lowest ratings, while the Prof10+ group provided the highest ratings (Figure 3-1). For anger, the Prof<10 group provided the lowest likeliness ratings, while the Low-Experience group provided the highest ratings. In contrast, for sadness, the Low-Experience group provided the lowest ratings, while the Prof10+ group provided the highest ratings.

**Other emotions.** There were no significant differences among the experience groups in their ratings of the likeliness that dogs experience disgust, $F(3, 2159) = 1.71, P$
Figure 3-1. Ratings of likeliness that dogs experience various basic emotions by experience group. Ratings varied by experience for fear, anger, and sadness ($p < .05$), but not for happiness.

Figure 3-2. Ratings of likeliness that dogs experience other emotions by experience group. Ratings varied by experience for surprise, love, frustration, and guilt ($p < .005$), but not disgust.
However, ratings of the likeliness of love, frustration, guilt, and surprise varied by experience, \( F(3, 2159) = 8.48, P < .001; F(3, 2159) = 30.37, P < .001; F(3, 2159) = 40.13, P < .001; F(3, 2159) = 20.24, P = .002 \). Ratings of the likeliness of frustration and surprise increased with experience, and the Low-Experience group provided the lowest ratings, while the Prof10+ group provided the highest ratings (Figure 3-2). For love, Low-Experience respondents provided the lowest likeliness ratings, while the Owners group provided the highest ratings. For guilt, the Low-Experience group provided the highest likeliness ratings, while the Prof<10 group provided the lowest ratings.

**Arousal.** There were no significant differences among the experience groups in their ratings of the likeliness that dogs experience excitement, \( F(3, 2159) = .99, P = .40 \).

**Discussion**

An exploration of the sample revealed a wide range of experience with dogs, demographics, prior learning about dog behavior, and knowledge of dog behavior. Participants were divided into four major experience categories based on their previous experience with dogs (Low-Experience, Owners, Prof<10, Prof10+). Demographic information, dog-keeping variables, and dog behavior knowledge were compared across the experience groups. As would be expected, the experience groups varied in their interactions with dogs. The total number of dogs owned in adulthood, the number of dogs interacted with daily, and interaction with one’s own dogs increased with experience. These findings support the method of grouping the participants into the four major experience categories.

More-experienced respondents also tended to be older; older individuals would have had more opportunities to acquire experience with dogs. In addition, they were
more likely to be female. The sex bias is not unusual for studies involving dog owners. Previous studies using questionnaire methodology found that about 80% of respondents were female (Kubinyi, Turcsán, & Miklósi, 2009; Ley, Bennett, & Coleman, 2009; Wan, Kubinyi, Miklósi, & Champagne, 2009).

Analyses indicated that several measures of dog behavior knowledge varied by experience. Scores on a brief dog behavior knowledge assessment increased with experience, as did self-ratings of participants’ ability to interpret dog behavior. In addition, more-experienced respondents were more likely to have learned to interpret the body language of dogs by reading a book, watching a video, attending a lecture, or receiving an explanation from a behavior professional. Therefore, experience with dogs was associated with seeking and retaining dog behavior knowledge and with confidence in one’s own abilities to interpret dog behavior.

Lastly, ratings of the likeliness that dogs experience various emotions were compared across the experience groups. Likelihood ratings did not differ among the groups for excitement, happiness, and disgust. For all of the experience groups, excitement and happiness were rated as highly likely, while disgust was rated as unlikely. In contrast, the experience groups differed in their ratings of the likeliness of a variety of other emotions. For example, more-experienced respondents provided higher likelihood ratings for fear, surprise, and frustration, but lower ratings for anger and guilt.

As discussed in Chapter 1, previous researchers have proposed that evolutionary and neurobiological evidence support the existence of some basic emotions, such as happiness and fear, in vertebrate species. In contrast, secondary emotions like guilt are generally believed to be less likely in nonhuman animals than basic emotions (Morris et
al., 2008). The findings in the current chapter suggest that perceptions of the likeliness of emotions are aligned with these theories.

Subsequent chapters will explore whether the experience groups differ in their perceptions of emotion in dogs. In order to determine the effect of experience, demographic variables that were found to differ among the experience groups (sex, age) will be controlled in some statistical analyses. In addition, since there were differences by experience in participants’ ratings of the likeliness that dogs experience certain emotions, likeliness ratings will be included as a covariate in analyses in Chapter 5 in order to determine the effect of experience on emotion categorizations after controlling for participants’ perceptions of the likeliness of these emotions in dogs.
CHAPTER 4

INTERSPECIFIC EXPERIENCE AND RATINGS OF EMOTION AND AROUSAL

Overview

Emotion theorists have proposed both dimensional (e.g. valence) and categorical (e.g. happy, sad) accounts of emotion production and perception (review: Barrett & Wager, 2006). The analyses below focus on interspecific emotion perception from a dimensional perspective, while Chapter 5 employs a categorical perspective.

The underlying dimensions of participants’ ratings are first explored and summarized with principal components analysis, and component scores are compared among the experience groups. If interspecific emotion perception develops in an experience-dependent manner, then individual differences in experience with dogs should result in significant differences in scores among the experience groups. In contrast, if a minimal baseline level of interspecific experience is required for the development of interspecific emotion perception, then the participants should produce similar interpretations, regardless of differences in dog experience.

Rating Scales

Table 4-1 provides descriptive statistics for the nine-point emotion rating scales across all participants for each set of videos described in Chapter 2 (high-agreement, positive-valence; high-agreement, negative-valence; low-agreement, positive-valence; low-agreement, negative-valence). The positive-valence videos, whether high- or low-agreement, tended to receive mean ratings on the “positive” sides of the scales (e.g. safe,
positive, loose, relaxed, happy, cheerful, peaceful, bold). The opposite effect was achieved for the high-agreement, negative-valence videos, which received mean ratings on the “negative” sides of the scales (e.g. unsafe, negative, tense, stressed, unhappy, sad, angry, fearful). Mean ratings for the low-agreement, negative-valence videos fell on both the “positive” and “negative” sides of the scales.

Table 4-1. Descriptive statistics for emotion rating scales by video grouping.

<table>
<thead>
<tr>
<th>Bipolar rating scales (1 = left term, 9 = right term)</th>
<th>High-agreement negative</th>
<th>High-agreement positive</th>
<th>Low-agreement negative</th>
<th>Low-agreement positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsafe/safe (M ± SD)</td>
<td>3.89 ± 2.02</td>
<td>7.85 ± 1.34</td>
<td>5.97 ± 2.37</td>
<td>7.19 ± 1.78</td>
</tr>
<tr>
<td>Negative/positive (M ± SD)</td>
<td>3.53 ± 1.49</td>
<td>7.66 ± 1.45</td>
<td>5.25 ± 2.29</td>
<td>6.16 ± 1.87</td>
</tr>
<tr>
<td>Excited/calm (M ± SD)</td>
<td>3.29 ± 1.78</td>
<td>3.69 ± 2.31</td>
<td>3.92 ± 2.13</td>
<td>6.15 ± 2.15</td>
</tr>
<tr>
<td>Tense/loose (M ± SD)</td>
<td>2.94 ± 1.49</td>
<td>6.78 ± 1.82</td>
<td>4.22 ± 2.20</td>
<td>6.02 ± 2.14</td>
</tr>
<tr>
<td>Relaxed/stressed (M ± SD)</td>
<td>6.90 ± 1.52</td>
<td>3.35 ± 1.81</td>
<td>5.63 ± 2.17</td>
<td>3.94 ± 2.14</td>
</tr>
<tr>
<td>Unhappy/happy (M ± SD)</td>
<td>3.92 ± 1.51</td>
<td>7.43 ± 1.50</td>
<td>5.23 ± 2.11</td>
<td>5.93 ± 1.76</td>
</tr>
<tr>
<td>Cheerful/sad (M ± SD)</td>
<td>5.24 ± .99</td>
<td>2.70 ± 1.65</td>
<td>4.40 ± 1.67</td>
<td>4.30 ± 1.53</td>
</tr>
<tr>
<td>Peaceful/angry (M ± SD)</td>
<td>5.60 ± 1.22</td>
<td>3.29 ± 1.53</td>
<td>4.66 ± 1.58</td>
<td>3.53 ± 1.64</td>
</tr>
<tr>
<td>Bold/fearful (M ± SD)</td>
<td>5.89 ± 2.07</td>
<td>3.79 ± 1.50</td>
<td>5.28 ± 1.85</td>
<td>4.88 ± 1.30</td>
</tr>
</tbody>
</table>

In order to determine the underlying structure of the data and investigate a possible dimensional account of interspecific emotion perception, principal components analysis with varimax rotation was conducted across all participants’ ratings. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .92. KMO values over .6 are generally recommended for principal components analysis (Dugard, Todman, & Staines, 2010). An eigenvalue of 1 was used for retention of components.

Two components explaining about 80% of the variance in the rotated solution were retained. A scree plot also supported the existence of two components. Factor loadings over .4 are considered interpretable (Stevens, 2002). Eight of the nine items loaded highly (> .6) in Component 1, which explained 59% of the variance (Table 4-2). The remaining item (excited/calm) loaded highly in Component 2, which explained 20% of the variance. Based on the items that loaded highly in each component, Component 1
was labeled Emotional Valence, while Component 2 was labeled Arousal. A Cronbach’s alpha of .94 for the Emotional Valence items revealed high internal consistency. Using all of the ratings, component scores were calculated for each video for each participant for use in further analyses. For interpretation of tables and figures later in the chapter, it should be noted that the component scores have a mean of 0 and a standard deviation of 1.

Table 4-2. Summary of principal components analysis on participant ratings.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rotated Factor Loadings</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Valence</td>
<td>Arousal</td>
<td></td>
</tr>
<tr>
<td>unsafe/safe</td>
<td>.75</td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>negative/positive</td>
<td>.92</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>tense/loose</td>
<td>.79</td>
<td>.46</td>
<td></td>
</tr>
<tr>
<td>relaxed/stressed</td>
<td>-.78</td>
<td>-.48</td>
<td></td>
</tr>
<tr>
<td>unhappy/happy</td>
<td>.92</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>cheerful/sad</td>
<td>-.87</td>
<td>.08</td>
<td></td>
</tr>
<tr>
<td>peaceful/angry</td>
<td>-.69</td>
<td>-.52</td>
<td></td>
</tr>
<tr>
<td>bold/fearful</td>
<td>-.75</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td>excited/calm</td>
<td>-.06</td>
<td>.93</td>
<td></td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>5.27</td>
<td>1.79</td>
<td></td>
</tr>
<tr>
<td>% of variance</td>
<td>58.56</td>
<td>19.88</td>
<td></td>
</tr>
</tbody>
</table>

Note: Factor loadings over .6 appear in bold.

**Statistical Analyses of Emotional Valence and Arousal Scores**

Since the focus of the dissertation is to determine whether experience plays a role in interspecific interpretations of emotion, the analyses focused on comparisons among the experience groups, rather than comparison of each experience group to a “correct” answer. In fact, dimensional scales are not as amenable as categorizations are for such comparisons. Therefore, in the next chapter, the expert panel’s emotion categorizations will be compared with participants’ categorizations.
In the current analyses, in order to determine whether experience with dogs contributed to interpretations, linear mixed models were conducted on the Emotional Valence and Arousal component scores. Separate models were run on each set of scores. The videos were entered as a repeated measure for each participant. In addition, the video identification variable and the experience category variable were entered as fixed effects, and the type III test of fixed effects was used to evaluate the significance of experience after controlling for the effects of individual videos. (For all analyses, the video variable was significantly associated with the outcome variables, indicating that responses varied across videos. However, this variable was of limited theoretical interest for the current research and was primarily included as a control variable, so the results are not addressed in further detail.) Since there were sex and age biases among the experience groups, an additional model was run on each outcome variable that also included sex and age as predictor variables in order to determine the effect of experience after adjusting for sex and age.

The model-adjusted means of Emotional Valence and Arousal scores are displayed later in the chapter in tables and figures for each experience group. The unadjusted means are similar to the adjusted means and are shown for the initial analyses for comparison purposes. Since there was variation among participants in the particular videos received (see Chapter 2), the design is considered unbalanced, and the adjusted means account for this imbalance by controlling for the effects of individual videos. Pairwise comparisons were conducted among the adjusted means, and $p$-values were Sidak-corrected for multiple comparisons.
Differences in ratings between the professional groups and the less-experienced groups could potentially be explained by professional education about dog behavior, rather than by increased exposure to dogs. There were only a small number of individuals in the Prof<10 ($N = 20$) and Prof10+ groups ($N = 17$) who reported that they had never learned about dog body language. Therefore, in order to separate the effect of simple exposure to dogs from the effect of professional education, additional analyses were conducted to explore the role of experience with dogs within the Owners group alone. Namely, the total number of dogs owned as an adult, the number of dogs interacted with daily, and the number of hours spent with one’s dogs on the average weekday were explored as possible predictors of owners’ responses. Due to the large range and skewness of the data for the first two variables, they were dichotomized around the median.

In addition, since behavior professionals were the subset of respondents to have received the most education about dog behavior, further analyses on the whole sample, but excluding the behavior professionals, were conducted. The two professional groups were merged for this analysis due to the smaller sizes of these groups after exclusion of the behavior professionals.

Analyses of Arousal and Emotional Valence scores across all the videos are first presented to provide a general overview of differences among the experience groups when a diverse range of behaviors is considered. Then, analyses of Emotional Valence scores for videos grouped by valence and agreement (Chapter 2) are discussed. Since the dissertation focuses on interpretations of emotion, analyses of Arousal scores by video groupings are not presented.
Does Experience with Dogs Predict Ratings of Arousal in Dogs?

All Videos

All participants. When responses to all videos were considered, experience was a significant predictor of Arousal scores, $F(3, 15162.09) = 8.96, P < .001$. As displayed in Figure 4-1, the Prof10+ group viewed the dogs as more excited than any of the other experience groups (Low-Experience: $P < .001$, Owners: $P = .007$, Prof<10: $P < .001$). In addition, the Owners group provided higher arousal scores than the Low-Experience group ($P < .05$). However, as the means and parameter estimates in Tables 4-3 and 4-4 suggest, the sizes of the effects were modest.

![Figure 4-1. Mean Arousal scores for each experience group.](image)

In this and subsequent figures, means are model-adjusted, and error bars represent standard errors of the mean.
Table 4-3. Mean Arousal scores by experience group.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>Low-Exp (n = 152)</th>
<th>Owners (n = 1462)</th>
<th>Prof&lt;10 (n = 307)</th>
<th>Prof10+ (n = 242)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted M (SE)</td>
<td>-.02 (.02)</td>
<td>.01 (.02)</td>
<td>-.05 (.01)</td>
<td>.02 (.03)</td>
</tr>
<tr>
<td>Adjusted M (SE)*</td>
<td>-.05 (.02)</td>
<td>-.0009 (.006)</td>
<td>-.04 (.01)</td>
<td>.05 (.01)</td>
</tr>
</tbody>
</table>

*Sig. pairwise comparisons among model-adjusted means: All < Prof10+; Low-Exp < Own.

Table 4-4. Parameter estimates modeling effect of experience on Arousal scores.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>B (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof10+</td>
<td>.10 (.02)**</td>
<td>.05, .14</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.02 (.02)</td>
<td>-.03, .06</td>
</tr>
<tr>
<td>Owners</td>
<td>.05 (.02)*</td>
<td>.01, .09</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *P < .01, **P < .001

Experience remained a significant predictor after adjusting for the sex and age of respondents, $F(3, 15152.65) = 2.79, P = .04$. Age was also a significant predictor, though sex was not, $b = .004, t(15242.73) = 10.50, P < .001$ and $b = -.02, t(14946.09) = -1.23, P = .22$. Supplementary analyses on the responses of dog professionals, owners, and all participants except for behavior professionals are included in Appendix D.

**Does Experience with Dogs Predict Ratings of Emotion in Dogs?**

**All Videos**

**All participants.** When responses to all videos were considered, experience was a significant predictor of Emotional Valence scores, $F(3, 15715.58) = 36.26, P < .001$. (Higher scores indicated more positive emotional interpretations, while lower scores indicated more negative interpretations.) Both groups of professionals interpreted the dogs as feeling significantly more negative than the Owners and Low-Experience groups, as displayed in Figure 4-2 and Table 4-5. The most negative ratings were provided by the Prof10+ group, while the most positive ratings were provided by the Owners group. The sizes of the effects were again modest.
Figure 4-2. Mean Emotional Valence scores for each experience group.

Table 4-5. Parameter estimates modeling effect of experience on Emotional Valence scores.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>B (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof10+</td>
<td>-.10 (.02)*</td>
<td>-.14, -.05</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>-.08 (.02)*</td>
<td>-.12, -.04</td>
</tr>
<tr>
<td>Owners</td>
<td>.03 (.02)</td>
<td>-.01, .06</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *P < .001

Experience remained a significant predictor of Emotional Valence scores even after adjusting for the sex and age of respondents, $F(3, 15708.49) = 30.52$, $P < .001$. Sex was also a significant predictor in this model with females providing more negative ratings, $b = -.06$, $t(15592.92) = -4.64$, $P < .001$. Age was not a significant predictor, $b = -.0004$, $t(15614.66) = -1.25$, $P = .21$. Supplementary analyses are included in Appendix D.

Video Groupings
All participants. As displayed in Figure 4-3, all of the experience groups provided the most positive Emotional Valence scores for the high-agreement, positive-valence videos and the most negative scores for the high-agreement, negative-valence videos. Scores for the low-agreement videos fell in the middle. Additional analyses demonstrated that all of the experience groups, except for the Low-Experience group, rated the low-agreement, positive-valence videos as significantly more positive than the low-agreement, negative-valence videos (Table 4-6).

Within each video grouping, experience was a significant predictor of Emotional Valence scores [High-agreement, positive-valence: $F(3, 6316.63) = 9.83, P < .001$; High-agreement, negative-valence: $F(3, 4247.48) = 23.91, P < .001$; Low-agreement, positive-valence: $F(3, 3182.08) = 9.42, P < .001$; Low-agreement, negative-valence: $F(3, 2840.81) = 23.57, P < .001$]. The effect of experience remained significant after
Table 4-6. Parameter estimates for models investigating effect of valence of low-agreement videos on Emotional Valence scores.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>B (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof10+</td>
<td>.31 (.06)*</td>
<td>.20, .42</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.35 (.05)*</td>
<td>.25, .45</td>
</tr>
<tr>
<td>Owners</td>
<td>.24 (.02)*</td>
<td>.19, .28</td>
</tr>
<tr>
<td>Low-Experience</td>
<td>.05 (.06)</td>
<td>-.08, .17</td>
</tr>
</tbody>
</table>

Fixed effect: Low-agreement video valence.
Reference category: low-agree, neg-val videos. *P < .001
Separate models for each experience group.

controlling for sex and age [High-agreement, positive-valence: $F(3, 6314.94) = 11.05, P < .001$; High-agreement, negative-valence: $F(3, 4242.57) = 20.85, P < .001$; Low-agreement, positive-valence: $F(3, 3180.20) = 7.41, P < .001$; Low-agreement, negative-valence: $F(3, 2837.90) = 14.02, P < .001$].

Pairwise comparisons are summarized below Figure 4-3. The largest differences among the experience groups were found for ratings of the low-agreement, negative-valence videos. Emotional interpretations became increasingly negative with experience. All comparisons were significant, except for the comparison between the two professional groups. The smallest differences among the experience groups occurred for the high-agreement, positive-valence videos.

**Behavior professionals excluded.** The patterns of results were similar when behavior professionals were removed from the analysis (Figure 4-4). For all video groupings except the low-agreement, positive-valence set, experience remained a significant predictor of Emotional Valence scores [High-agreement, positive-valence: $F(2, 5241.62) = 9.90, P < .001$; High-agreement, negative-valence: $F(2, 3508.86) = 5.90, P = .003$; Low-agreement, positive-valence: $F(2, 2596.95) = 1.73, P = .18$; Low-agreement, negative-valence: $F(2, 2342.28) = 12.50, P < .001$]. The experience groups
differed the most in ratings for the low-agreement, negative-valence videos, for which interpretations became increasingly negative with experience.

![Figure 4-4. Mean Emotional Valence scores by experience for each video grouping; behavior professionals excluded. Sig. pairwise comparisons: High-agree, pos-val: Low-Exp < Owners, Prof; Low-agree, neg-val: Prof < Owners < Low-Exp; High-agree, neg-val: Prof < Owners.](image)

**Owners only.** Within the Owners group, the number of dogs owned as an adult predicted Emotional Valence scores for high-agreement, positive-valence videos and low-agreement, negative-valence videos [High-agreement, positive-valence: \( b = .06, t(4262.83) = 2.98, P = .003 \); High-agreement, negative-valence: \( b = .04, t(2870.29) = 1.77, P = .08 \); Low-agreement, positive-valence: \( b = .01, t(2145.99) = .47, P = .64 \); Low-agreement, negative-valence: \( b = -.13, t(1965.14) = -3.51, P < .001 \)]. Compared to less-experienced dog owners, individuals who had owned five or more dogs provided more positive ratings for high-agreement, positive-valence videos (Figure 4-5). In addition, they provided more negative ratings for low-agreement, negative-valence videos. The size of the difference was larger for the low-agreement set.
Figure 4-5. Mean Emotional Valence scores by total number of dogs owned (in adulthood) for each video grouping; Owners group only. *P < .005, **P < .001.

The number of dogs interacted with daily predicted Emotional Valence scores for high-agreement, positive-valence videos only [High-agreement, positive-valence: $b = .06, t(4269.10) = 3.15, P = .002$; High-agreement, negative-valence: $b = -.009, t(2865.27) = -.43, P = .67$; Low-agreement, positive-valence: $b = -.004, t(2144.07) = .15, P = .88$; Low-agreement, negative-valence: $b = -.06, t(1959.39) = -1.71, P = .09$]. For these videos, individuals who interacted with three or more dogs per day provided more positive ratings. However, the magnitude of the difference was small.

The number of hours per day that owners reported spending with their dogs predicted Emotional Valence scores for the low-agreement, negative-valence videos only [High-agreement, positive-valence: $b = .002, t(3716.30) = .90, P = .37$; High-agreement, negative-valence: $b = -.0009, t(2507.92) = -.42, P = .67$; Low-agreement, positive-valence: $b = .003, t(1903.49) = .89, P = .38$; Low-agreement, negative-valence: $b = -.01$,}
$t(1679.62) = -2.87, P = .004$. Emotional interpretations became more negative as the number of hours that owners spent with their dogs increased (Figure 4-6).

![Figure 4-6. Significant negative association between number of hours owners spent with their dogs per weekday (not including time that owner spent sleeping) and Emotional Valence scores for low-agreement, negative-valence videos. Markers represent mean Emotional Valence scores across owners at each reported duration.](image)

**Discussion**

Analyses in this chapter provided evidence for the experience-dependent development of interspecific emotion perception, particularly with regards to negatively-valenced emotion (as assessed by the initial expert panel). Individual differences in participants’ direct experience with dogs were associated with their perceptions of emotion in dogs. Respondents’ perceptions became more negative with experience for all but the high-agreement, positive-valence videos. When the videos were analyzed together, the magnitudes of the differences among the experience groups were small. However, when the videos were grouped by valence and agreement (as described in
Chapter 2), it became apparent that there were larger differences among the groups, especially in interpretations of the negative-valence videos.

The largest differences by experience were found for the low-agreement, negative-valence videos. These findings are consistent with the human literature, which has found that the interpretation of subtle facial expressions, especially expressions depicting negative emotions, develops gradually and can be difficult even for adults to decode (Gao & Maurer, 2009, 2010; Kohler et al., 2003). The low intensity of these facial expressions can be compared to the weak valence of the low-agreement videos. In addition, the perception of negative emotions has previously been shown to be susceptible to individual differences in experience. For example, the perception and recognition of negative facial expressions, such as anger, is influenced by abuse (Pollak, et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002; M. W. Sullivan, et al., 2008).

The differences among the experience groups were smallest for high-agreement, positive-valence videos, supporting previous intraspecific research on the perception of positive emotions. For example, studies on human facial expression recognition have consistently demonstrated that happy expressions are identified with the greatest accuracy in a variety of different populations and that the ability to recognize happy expressions develops with less social exposure than the ability to recognize negative expressions (Camras & Allison, 1985; Durand, et al., 2007; Kolb, et al., 1992; Vicari, et al., 2000). In addition, the perception of happy expressions is less influenced by individual-specific experiences like abuse (Pollak, et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002; M. W. Sullivan, et al., 2008). These findings, in addition to the current results, suggest that the perception of positive emotions may develop as a result of typical
neurobehavioral maturation combined with a baseline of social exposure, while the perception of negative emotions may also be susceptible to experience-dependent processes.

Though emotion ratings varied by experience, the fact that all of the groups provided the most positive ratings for high-agreement, positive-valence videos and the most negative ratings for high-agreement, negative-valence videos suggests that even individuals with little dog experience may be able to distinguish clearly positive emotion from clearly negative emotion. However, one of the more interesting findings was that the Low-Experience group did not distinguish between positive- and negative-valence videos of low agreement, whereas all of the other groups provided more positive interpretations of the positive-valence set. This result further corroborates the view stated earlier that the perception of weakly-valenced emotional signals may develop in an experience-dependent manner.

Analyses using measures of experience other than the broad experience categories yielded similar patterns of results and supported the experience-dependent hypothesis. For example, within the Owners group, individuals who had owned five or more dogs tended to provide more positive interpretations of the high-agreement, positive-valence videos and more negative interpretations of the low-agreement, negative-valence videos. The effect of increased ownership was larger for the negative- than positive-valence videos. Similarly, the number of hours that owners spent with their dogs was negatively associated with Emotional Valence scores for the low-agreement, negative-valence videos. Owners who spent more time with their dogs tended to provide more negative interpretations.
A somewhat unexpected result was that there appeared to be a strong dimensional structure to participants’ ratings. When the structure of the data was explored, most of the rated items were grouped together in a single component related to emotional valence, while the remaining item was related to arousal. Some human emotion researchers have advocated for a dimensional understanding of emotion perception. For example, Russell and others have proposed and found empirical support for a two-dimensional emotional space defined by valence and arousal (J. A. Russell, 1980; Yik, Russell, & Barrett, 1999). The match between their dimensions and those in the current data are striking and further support the view that there are similarities between inter- and intraspecific emotion perception.
CHAPTER 5

INTERSPECIFIC EXPERIENCE AND EMOTION CATEGORIZATION

Overview

Results presented in Chapter 4 revealed that interpretations of emotion in dogs vary by experience with dogs, suggesting that interspecific emotion perception may develop in an experience-dependent manner. Analyses also revealed that the data could be reduced to two dimensions (valence and arousal), similar to previously proposed dimensional accounts of emotion. If interspecific emotion perception truly develops in an experience-dependent manner, then effects of experience should be demonstrated whether emotion is conceptualized as dimensional or categorical. The current chapter explores interspecific emotion perception from a categorical perspective. Results are expected to be aligned with those in the previous chapter: Categorizations are predicted to vary by experience, and the effect of experience is predicted to be most evident for categorizations of negative-valence videos.

Descriptive Statistics for Forced-Choice Emotion Categorizations

Across all videos and all participants, the most commonly selected emotion category was happy (46%), followed by fearful (24%), and neutral (23%). Angry (4%) and sad (3%) were the least common choices by a wide margin.

Figure 5-1 displays emotion categorizations for each video grouping. The happy category was the most popular (83%) for the high-agreement, positive valence videos,
distantly followed by the neutral category (14%). The fearful category (59%) was the most common for the high-agreement, negative-valence videos, followed by neutral (20%). There was less consensus for the low-agreement videos. For the positive-valence set, the happy and neutral category were equally popular at 40% and 41%. For the negative-valence set, 38% categorized the dogs as feeling happy, 30% selected fearful, and 25% selected neutral.

![Figure 5-1. Emotion categorizations by video grouping.](image)

**Statistical Analyses of Emotion Categorizations**

Logistic regression with generalized estimating equations was used to explore the relationship between experience and respondents’ emotion categorizations. Separate models were run on each emotion category with responses coded as 0 (non-selection) or 1 (selection). The videos were entered as a repeated measure for each participant. To evaluate the significance of experience after controlling for the effects of individual
videos, the video identification variable and the experience variable were entered as fixed effects. (As in the previous chapter, the video variable was significantly associated with the outcome variables, indicating that responses varied across videos. However, this variable was primarily included as a control variable, so the results are not addressed in further detail.) Pairwise comparisons were conducted among the experience groups, and \( p \)-values were Sidak-corrected for multiple comparisons.

Since there were sex and age biases among the experience groups, an additional model was run for each emotion category that also included sex and age as predictor variables in order to determine the effect of experience after adjusting for sex and age. In addition, since the experience groups differed in their ratings of the likeliness that dogs experience various discrete emotions, an additional model was run for each emotion category that controlled for respondents’ likeliness ratings. For example, a variable containing respondents’ ratings of the likeliness that dogs experience fear was added as a covariate in order to determine the effect of experience on fearful categorizations after accounting for perceptions of the likeliness of fear in dogs.

As described in the previous chapter, differences between the professional groups and the less-experienced groups could possibly be explained by professional education about dog behavior, rather than by increased exposure to dogs. Therefore, additional analyses were conducted with behavior professionals removed from the sample, as well as with experience-related predictor variables within the Owners group only.

Analyses on responses for all videos are first presented. Further analyses of video groupings are then presented for the most commonly-selected non-neutral emotion categories, happy and fearful. As a point of comparison, “happy” was the most common
selection by the initial expert panel for high-agreement, positive-valence videos, while “fearful” was the most common categorization for the high-agreement, negative-valence videos (Chapter 2).

**Does Experience with Dogs Predict Emotion Categorizations?**

**All Videos**

**All participants.** When all of the videos were considered together, experience was a significant predictor of happy, sad, fearful, and angry, but not neutral, categorizations, $Wald \chi^2(3, N = 2163) = 27.46, P < .001$; $Wald \chi^2(3, N = 2163) = 38.74, P < .001$; $Wald \chi^2(3, N = 2163) = 130.37, P < .001$; $Wald \chi^2(3, N = 2163) = 43.44, P < .001$; and $Wald \chi^2(3, N = 2163) = 6.78, P = .08$. Odds ratios (OR) with the Low-Experience group as a reference category are displayed in Table 5-1, and the model-adjusted probability of selection of each emotion category is displayed in Figure 5-2.

Compared to less-experienced respondents, professionals tended to be less likely to identify the dogs in the videos as happy. For example, the odds of selecting happy were 1.29 times higher for the Low-Experience group than the Prof10+ group. In contrast, the likelihood of selecting “fearful” increased with experience. All groups differed significantly, except for the two professional groups. Compared to the Low-Experience group, the odds of selecting fearful were more than twice as high in the Owners group and more than three times higher in the two professional groups.

The angry and sad categories were less frequently selected, and the differences among the groups were much smaller, though still significant. Selection of both categories tended to decrease as experience increased. The odds of the Low-Experience group selecting angry were 2.7 times higher (inverted OR from Table 5-1) than
Table 5-1. Odds ratios for effect of experience on emotion categorizations.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof10+</td>
<td>.78*</td>
<td>.62, .97</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.89</td>
<td>.73, 1.10</td>
</tr>
<tr>
<td>Owners</td>
<td>1.11</td>
<td>.93, 1.33</td>
</tr>
<tr>
<td>Fearful</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof10+</td>
<td>3.25**</td>
<td>2.56, 4.12</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>3.22**</td>
<td>2.57, 4.04</td>
</tr>
<tr>
<td>Owners</td>
<td>2.20**</td>
<td>1.79, 2.70</td>
</tr>
<tr>
<td>Angry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof10+</td>
<td>.32**</td>
<td>.22, .47</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.36**</td>
<td>.25, .52</td>
</tr>
<tr>
<td>Owners</td>
<td>.37**</td>
<td>.27, .51</td>
</tr>
<tr>
<td>Sad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof10+</td>
<td>.34**</td>
<td>.23, .52</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.32**</td>
<td>.21, .49</td>
</tr>
<tr>
<td>Owners</td>
<td>.48**</td>
<td>.36, .64</td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof10+</td>
<td>.92</td>
<td>.75, 1.13</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.81**</td>
<td>.66, .98</td>
</tr>
<tr>
<td>Owners</td>
<td>.83**</td>
<td>.71, .98</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience.  *P < .05, **P < .001  
*aOverall $\chi^2$ for experience was not significant for neutral

Figure 5-2. Probability of selection of five emotion categories by experience group; all videos combined. Sig. pairwise comparisons (Sidak-corrected): Happy: Prof<10, Prof10+ < Own; Fearful: Low-Exp < Own < Prof<10, Prof10+; Angry: Low-Exp > all; Sad: Low-Exp > all. Probabilities in this and subsequent figures are model-adjusted as described in the text.
the Owners group, 2.8 times higher than the Prof<10 group, and 3.1 times higher than the Prof10+ group. In addition, the odds of selecting sad in the Low-Experience group were about two times higher than the Owners group and about three times higher than the two professional groups.

Experience remained a significant predictor of happy, fearful, angry, and sad categorizations after accounting for respondents’ ratings of the likeliness of these emotions in dogs, $Wald \chi^2(3, N = 2163) = 27.51, P < .001$, $Wald \chi^2(3, N = 2163) = 127.96, P < .001$, $Wald \chi^2(3, N = 2163) = 42.43, P < .001$, and $Wald \chi^2(3, N = 2163) = 38.80, P < .001$. In addition, experience remained a significant predictor of emotion categorizations after adjusting for the sex and age of respondents [happy: $Wald \chi^2(3, N = 2163) = 21.78, P < .001$; fearful: $Wald \chi^2(3, N = 2163) = 74.81, P < .001$; angry: $Wald \chi^2(3, N = 2163) = 10.05, P = .02$; and sad: $Wald \chi^2(3, N = 2163) = 21.73, P < .001$].

There were no changes in the patterns of results when these factors were controlled.

Supplementary analyses on the categorizations of dog professionals only, owners only, and all participants except for behavior professionals are included in Appendix E.

**Video Groupings**

**All participants.**

*Happy category.* For all experience groups, the likelihood of selecting happy was highest for the high-agreement, positive-valence videos and lowest for the high-agreement, negative-valence videos, while the low-agreement videos fell in-between (Figure 5-3). Additionally, all of the experience groups, except for the Low-Experience group, were slightly more likely to select happy for the low-agreement, positive-valence videos than the low-agreement, negative-valence videos. In contrast, the Low-
Experience group exhibited the opposite pattern. They were more likely to select happy for the low-agreement, negative-valence videos, and the difference was marginally significant, $OR = 1.37, P = .09$.

![Figure 5-3. Probability of happy categorizations for each video grouping by experience. Sig. pairwise comparisons (Sidak-corrected): High-agree, pos-val: Low-Exp < Own, Prof<10; Low-agree, pos-val: Prof<10, Prof10+ < Own; Low-agree, neg-val: Prof<10, Prof10+ < Low-Exp; Prof10+ < Own; High-agree, neg-val: Prof10+ < Own.](image)

Within each video grouping, the likelihood of happy categorizations was significantly associated with experience [high-agree, pos-val: $Wald \chi^2(3, N = 2163) = 21.31, P < .001$; low-agree, pos-val: $Wald \chi^2(3, N = 2163) = 12.86, P = .005$; low-agree, neg-val: $Wald \chi^2(3, N = 2163) = 23.12, P < .001$; high-agree, neg-val: $Wald \chi^2(3, N = 2163) = 8.17, P = .04$]. The Low-Experience group was less likely than more-experienced groups to categorize high-agreement, positive-valence videos as happy. The happy category was the most common selection by the expert panel for these videos, and therefore, it can be said that the perceptions of the Low-Experience group were less aligned with expert evaluations than the other groups. The sizes of the effects were
The smallest differences among the experience groups were found for the high-agreement, negative-valence videos, for which the happy category was infrequently chosen by all experience groups. The largest differences among the experience groups were found for the low-agreement, negative-valence videos. The likelihood of selecting happy decreased as experience increased. For example, the odds of selecting happy by the Low-Experience group were 1.39 times higher than the Owners group \( (P = .02) \), 1.77 times higher than the Prof<10 group \( (P = .001) \), and 2.17 times higher than the Prof10+ group \( (P < .001) \).

Fearful category. For most experience groups, the likelihood of selecting fearful was highest for the high-agreement, negative-valence videos and lowest for the high-agreement, positive-valence videos, with the likelihoods for the low-agreement videos falling in between (Figure 5-4). However, for the Low-Experience group, the likelihood of selecting fearful did not differ between the high- and low-agreement, positive-valence videos \( (OR = .99, P = .99) \). In contrast, more-experienced respondents were significantly more likely to select fearful for the low-agreement, positive-valence set than the high-agreement, positive-valence set (Owners: \( OR = 7.97, CI = 6.13 – 10.37, P < .001 \); Prof<10: \( OR = 5.64, CI = 3.47 – 9.18, P < .001 \); Prof10+: \( OR = 10.83, CI = 6.10 – 19.23, P < .001 \)).

Within each video grouping, the likelihood of fearful categorizations was significantly associated with experience [high-agree, pos-val: \( Wald \chi^2(3, N = 2163) = \)]
Figure 5-4. Probability of fearful categorizations for each video grouping by experience. Sig. pairwise comparisons (Sidak-corrected): Low-agree, pos-val: Low-Exp < all; Low-agree, neg-val: Low-Exp < all; Own < Prof<10; High-agree, neg-val: Low-Exp < Own < Prof<10, Prof10+.

8.87, $P = .03$; low-agree, pos-val: $Wald \chi^2(3, N = 2163) = 23.55, P < .001$; low-agree, neg-val: $Wald \chi^2(3, N = 2163) = 25.39, P < .001$; high-agree, neg-val: $Wald \chi^2(3, N = 2163) = 104.65, P < .001].$ The smallest differences among the experience groups were found for the high-agreement, positive-valence set, for which the fearful category was infrequently chosen by all experience groups. The largest differences among the experience groups occurred for the high-agreement, negative-valence videos. The likelihood of selecting fearful increased dramatically with experience, and all groups differed significantly, except for the two professional groups. For example, compared to the Low-Experience group, the odds of selecting fearful were 2.87 times higher in the Owners group ($CI = 2.19 – 3.77, P < .001$), 4.58 times higher in the Prof<10 group ($CI = 3.34 – 6.28, P < .001$), and 4.59 times higher in the Prof10+ group ($CI = 3.26 – 6.46, P < .001$). The fearful category was the most common selection by the expert panel for the high-agreement, negative-valence videos. Therefore, as experience increased,
participants’ emotion categorizations became increasingly aligned with expert evaluations, and the odds ratios indicated large effects.

**Behavior professionals excluded.**

**Happy category.** When behavior professionals were removed from the analysis, experience remained a significant predictor of happy categorizations for the low-agreement, negative-valence videos, as well as the high-agreement, positive-valence videos, $Wald \chi^2(2, N = 1779) = 7.51, P = .02$ and $Wald \chi^2(2, N = 1779) = 21.72, P < .001$. As displayed in Figure 5-5, as experience increased, selection of the happy category decreased for the low-agreement, negative-valence videos and increased for the high-agreement, positive-valence videos. However, the experience groups did not vary in happy categorizations for the high-agreement, negative-valence videos and low-agreement, positive-valence videos, $Wald \chi^2(2, N = 1779) = .74, P = .69$ and $Wald \chi^2(2, N = 1779) = 2.39, P = .30$.

![Figure 5-5](image-url)

**Figure 5-5.** Probability of happy categorizations for each video grouping by experience; behavior professionals excluded. Sig. pairwise comparisons (Sidak-corrected): High-agree, pos-val: Low-Exp < Own, Prof; Low-agree, neg-val: Prof < Low-Exp.
Fearful category. When behavior professionals were removed from the analysis, experience remained a significant predictor of fearful categorizations for all video groupings, except for the high-agreement, positive-valence videos [high-agree, pos-val: \( \chi^2(2, N = 1779) = 5.51, P = .06 \); low-agree, pos-val: \( \chi^2(2, N = 1779) = 14.20, P = .001 \); low-agree, neg-val: \( \chi^2(2, N = 1779) = 10.04, P = .007 \); high-agree, neg-val: \( \chi^2(2, N = 1779) = 73.17, P < .001 \)]. Results are displayed in Figure 5-6. As was found in the full sample, the experience groups differed the most in their likelihood of selecting the fearful category for high-agreement, negative-valence videos.

Owners only.

Happy category. Within the Owners group, the number of hours spent with one’s dogs was not associated with happy categorizations for any of the video sets [high-agree, pos-val: \( OR = 1.01, P = .64 \); low-agree, pos-val: \( OR = 1.01, P = .60 \); low-
agree, neg-val: \( OR = .99, P = .13 \); high-agree, neg-val: \( OR = 1.00, P = .94 \). However, as depicted in Figure 5-7, respondents who had owned five or more dogs were significantly less likely to select happy for the low-agreement, negative-valence videos and more likely to select happy for the high-agreement, positive-valence set [high-agree, pos-val: \( OR = 1.49, CI = 1.20 - 1.86, P < .001 \); low-agree, pos-val: \( OR = .97, P = .77 \); low-agree, neg-val: \( OR = .78, CI = .65 - .94, P = .01 \); high-agree, neg-val: \( OR = 1.05, P = .77 \)]. In addition, those who interacted with three or more dogs per day were marginally more likely to categorize dogs in the high-agreement, positive-valence videos as happy [high-agree, pos-val: \( OR = 1.23, P = .05 \); low-agree, pos-val: \( OR = 1.03, P = .75 \); low-agree, neg-val: \( OR = .98, P = .84 \); high-agree, neg-val: \( OR = .92, P = .62 \)].

**Fearful category.** The experience-related predictor variables within the Owners group were also associated with fearful categorizations. Respondents who had
Figure 5-8. Probability of fearful categorizations by total number of dogs owned (in adulthood) for each video grouping; owners only. *P < .05.

Figure 5-9. Probability of fearful categorizations for each video grouping by number of dogs interacted with daily; owners only. *P < .005.
owned five or more dogs were more likely to categorize dogs in the low-agreement, negative-valence videos as fearful [high-agree, pos-val: \( OR = 0.93, \ P = .77 \); low-agree, pos-val: \( OR = 1.14, \ P = .37 \); low-agree, neg-val: \( OR = 1.30, \ CI = 1.06 – 1.59, \ P = .01 \); high-agree, neg-val: \( OR = 1.09, \ P = .37 \)]. In addition, those who interacted with three or more dogs per day were more likely to categorize dogs in the high-agreement, negative-valence videos as fearful [high-agree, pos-val: \( OR = 0.85, \ P = .53 \); low-agree, pos-val: \( OR = 1.08, \ P = .58 \); low-agree, neg-val: \( OR = 0.97, \ P = .77 \); high-agree, neg-val: \( OR = 1.30, \ CI = 1.09 – 1.56, \ P = .004 \)]. Figure 5-8 and Figure 5-9 display these results.

Lastly, the number of hours spent with one’s dogs was associated with fearful categorizations for all video sets, except the low-agreement, positive-valence videos [high-agree, pos-val: \( OR = 1.07, \ CI = 1.02 – 1.12, \ P = .004 \); low-agree, pos-val: \( OR = 1.01, \ P = .49 \); low-agree, neg-val: \( OR = 1.02, \ CI = 1.00-1.04, \ P = .046 \); high-agree, neg-val: \( OR = 1.03, \ CI = 1.01 – 1.05, \ P = .002 \)]. As the number of hours increased, owners were more likely to select the fearful category.

**Discussion**

Some emotion theorists have argued for a dimensional conceptualization of emotions, while others have argued for discrete emotion categories (Bimler & Kirkland, 2001; Calder, Young, Perrett, Etcoff, & Rowland, 1996; Etcoff & Magee, 1992; J. A. Russell, 1980; Yik, et al., 1999). Empirical support has been found for both perspectives, and therefore, both were included in the design of the current research. The previous chapter approached emotion in dogs from a dimensional perspective, while the current chapter approached the topic from a categorical perspective.
When responses to all of the videos were considered together, happy categorizations tended to decrease as experience increased, while fearful categorizations increased. Differences among the groups remained even when respondents’ ratings of the likeliness of each emotion were controlled. Therefore, differences among the experience groups did not result solely from divergent beliefs of the likeliness of each emotion, but rather from divergent perceptions of the viewed dogs’ emotions.

Analyses of video groupings were more revealing. In line with intraspecific research, it appears that the interspecific perception of positive emotions (as judged by the initial expert panel) may develop as a result of universally-experienced emotional cues, while the perception of negative emotions may be more susceptible to experience-dependent processes. Though there were differences among the experience groups, high-agreement, positive-valence videos were frequently categorized as “happy,” in line with expert evaluations, even by individuals lacking dog experience. In contrast, there was a very large effect of experience for high-agreement, negative-valence videos. For these videos, selection of the fearful category increased with experience, with the largest increase from the Low-Experience to the Owners group. Analyses using measures of experience other than the broad experience categories yielded similar patterns of results, although the sizes of the effects were smaller.

Results in the previous chapter had suggested that the Low-Experience group experienced difficulty distinguishing the valence of the low-agreement videos. The same result was obtained here for emotion categorizations. They were the only group to be more likely to select the happy category for the low-agreement, negative-valence videos than the low-agreement, positive-valence videos. These results are consistent with the
idea that the interpretation of weakly-valenced behaviors is more susceptible to the role of experience.

Even though less-experienced respondents were less likely to perceive fear than more-experienced respondents, they still appeared to distinguish clearly negative from clearly positive emotions. In the video grouping analyses, all experience groups were most unlikely to select “fearful” for high-agreement, positive-valence videos and most unlikely to select “happy” for high-agreement, negative-valence videos. The reverse pattern was true, as well: Selection of “happy” was most likely for high-agreement, positive-valence videos, and selection of “fearful” was most likely for high-agreement, negative-valence videos.

For all of the experience groups, angry and sad categorizations were infrequent compared to other categorizations, even though all of the experience groups believed that dogs were likely to experience these emotions (see Chapter 3). It is unclear whether this result was due to the fact that the videos did not provide clear examples of anger or sadness or due to hesitation to identify dogs as angry or sad. Among the small number of angry and sad categorizations, more were found in the Low-Experience group than the other groups, suggesting that even for infrequent categorizations, experience plays a role.

Previous findings on the decoding of emotion in dog vocalizations suggested that the development of interspecific emotion perception was primarily a universal, age-dependent process (Molnár, et al., in preparation; Molnár, et al., 2010; Pongrácz, Molnár, & Miklósi, 2006; Pongrácz, et al., 2005). Neither visual experience, nor experience with dogs, was required for accurate bark decoding. The recognition of emotion in canine facial expressions was also suspected to develop in a primarily age-dependent manner.
(Meints, Racca, et al., 2010). Until now, there has been limited evidence for the experience-dependent development of interspecific emotion perception (Lakestani, 2007; Tami & Gallagher, 2009), even though intraspecific emotion perception has been known to be influenced by such processes (Pollak, et al., 2000; Pollak & Kistler, 2002; Pollak & Sinha, 2002; M. W. Sullivan, et al., 2008). The results discussed in the previous and current chapters are among the first to demonstrate that interspecific emotion perception may be susceptible to experience-dependent development.
CHAPTER 6

THE INTERACTION OF LEARNING AND EXPERIENCE

Overview

Analyses in previous chapters suggested that the level of experience with dogs was associated with respondents’ emotion ratings and categorizations. Differences between professionals and less-experienced respondents were not due solely to professional education about dog behavior, since significant effects of experience were maintained in analyses with behavior professionals excluded. In addition, analyses of experiential variables within the Owners group (e.g. total number of dogs owned) also showed the effect of experience. However, even though respondents in the Low-Experience and Owners groups were not professionals, some reported that they had “learned to interpret the body language of dogs” by reading a book or article, attending a lecture, watching a video, or receiving an explanation from a behavior professional (see Chapter 3). In this chapter, I explore the effects of such learning and the interaction between learning and direct experience with dogs on emotion ratings and categorizations. (For analyses examining the role of experience after the exclusion of all participants who reported learning about dog body language, see Appendix F.)

Linear mixed models were conducted on respondents’ Emotional Valence scores, according to the procedures described in Chapter 4, and logistic regression with generalized estimating equations were conducted on happy and fearful emotion categorizations, as described in Chapter 5. In addition to the experience category and
video identification variables, the number of methods (0-4) used by respondents to learn about dog body language was included as a measure of the extent of learning. In addition, the interaction between the learning and experience variables was included in the models. Separate follow-up analyses were conducted as needed within each experience group.

**Do Learning and Experience Interact in Predicting Emotion Ratings?**

For Emotional Valence scores, the interaction between the level of learning and dog experience was significant for the high- and low-agreement, negative-valence videos [High-agreement, positive-valence: $F(3, 5990.90) = 1.32, P = .27$; Low-agreement, positive-valence: $F(3, 3229.00) = .17, P = .92$; Low-agreement, negative-valence: $F(3, 2673.66) = 3.43, P = .02$; High-agreement, negative-valence: $F(3, 4187.51) = 5.62, P = .001$]. There was no main effect for learning in any of the video groupings [High-agree, pos-val: $F(1, 5633.04) = .00005, P > .99$; Low-agree, pos-val: $F(1, 3276.36) = 2.33, P = .13$; Low-agree, neg-val: $F(1, 2581.52) = 2.70, P = .10$; High-agree, neg-val: $F(1, 4278.30) = 1.04, P = .31$]. However, for all except the low-agreement, positive-valence videos, experience remained a significant predictor of Emotional Valence scores over and above the effects of learning and the interaction between learning and experience [High-agreement, positive-valence: $F(3, 6292.78) = 10.22, P < .001$; Low-agreement, positive-valence: $F(3, 3190.27) = 1.36, P = .25$; Low-agreement, negative-valence: $F(3, 2719.19) = 4.30, P = .005$; High-agreement, negative-valence: $F(3, 4185.40) = 3.27, P = .02$].

For the high-agreement, negative-valence set, follow-up analyses demonstrated that the number of learning methods predicted Emotional Valence scores within all experience groups [Low-Experience: $b = .22, t(290.16) = 3.14, P = .002$; Owners: $b = -$
.04, \( t(2842.38) = -5.25, P < .001 \); Prof<10: \( b = -.05, t(587.74) = -3.42, P = .001 \); Prof10+: \( b = -.06, t(435.37) = -3.58, P < .001 \]. As learning increased in the Low-Experience group, emotional interpretations became more positive, while the opposite effect was observed for the other experience groups.

For the low-agreement, negative-valence videos, the number of learning methods was significantly associated with Emotional Valence scores only within the Owners and Prof<10 groups [Low-Experience: \( b = .02, t(209.28) = .23, P = .82 \); Owners: \( b = -.09, t(1959.10) = -7.45, P < .001 \); Prof<10: \( b = -.14, t(394.48) = -4.82, P < .001 \); Prof10+: \( b = -.02, t(283.01) = -.62, P = .53 \]. As learning increased, respondents from both groups tended to provide more negative interpretations of emotion.

**Do Learning and Experience Interact in Predicting Emotion Categorizations?**

**Happy Category**

For happy categorizations, the interaction between the learning and experience variables was significant only for the high-agreement, negative-valence videos [high-agree, pos-val: Wald \( \chi^2(3, N = 2163) = 1.90, P = .59 \); low-agree, pos-val: Wald \( \chi^2(3, N = 2163) = 3.68, P = .30 \); low-agree, neg-val: Wald \( \chi^2(3, N = 2163) = 5.87, P = .12 \); high-agree, neg-val: Wald \( \chi^2(3, N = 2163) = 10.10, P = .02 \). There was no main effect for learning in any of the video groupings [high-agree, pos-val: Wald \( \chi^2(1, N = 2163) = .19, P = .66 \); low-agree, pos-val: Wald \( \chi^2(1, N = 2163) = .63, P = .43 \); low-agree, neg-val: Wald \( \chi^2(1, N = 2163) = .63, P = .43 \); high-agree, neg-val: Wald \( \chi^2(1, N = 2163) = .07, P = .80 \]. For the high-agreement, positive-valence and low-agreement, negative-valence videos, experience remained a significant predictor of happy categorizations over and above the effects of learning and the interaction between learning and experience [high-

Follow-up analyses revealed that the number of learning methods significantly predicted happy categorizations for the high-agreement, negative-valence videos within the Low-Experience, Owners, and Prof10+ group, but the relationship was only marginally significant for the Prof<10 group [Low-Experience: $OR = 2.34, CI = 1.16 – 4.71, P = .02$; Owners: $OR = .86, CI = .76 - .97, P = .01$; Prof<10: $OR = .78, P = .08$; Prof10+: $OR = .71, CI = .51 - .98, P = .04$]. As learning increased, the Low-Experience group became more likely to select happy for the high-agreement, negative-valence videos, while the opposite pattern was revealed for the other experience groups. In addition, the size of the effect of learning appeared to decrease as experience increased.

**Fearful Category**

Analysis of fearful categorizations for the low-agreement, positive-valence videos resulted in an unstable model. For all other video groupings, the interaction between learning and experience was not significant [high-agree, pos-val: $Wald X^2(3, N = 2163) = 1.71, P = .64$; low-agree, neg-val: $Wald X^2(3, N = 2163) = 6.50, P = .09$; high-agree, neg-val: $Wald X^2(3, N = 2163) = 2.60, P = .46$]. There was no main effect for learning in any of the video groupings [high-agree, pos-val: $Wald X^2(1, N = 2163) = .06, P = .80$; low-agree, neg-val: $Wald X^2(1, N = 2163) = .21, P = .65$; high-agree, neg-val: $Wald X^2(1, N = 2163) = .17, P = .68$]. For all video sets except for the low-agreement, negative-valence videos, experience remained a significant predictor of fearful categorizations over and above the effects of learning and the interaction between learning and experience [high-
agree, pos-val: $Wald \chi^2(3, N = 2163) = 10.49, P = .02$; low-agree, neg-val: $Wald \chi^2(3, N = 2163) = 5.98, P = .11$; high-agree, neg-val: $Wald \chi^2(3, N = 2163) = 30.31, P < .001$.

**Discussion**

The results discussed in previous chapters suggested that the largest differences among the experience groups occurred for negative-valence videos. Here, I also found an interaction between respondents’ prior learning about dogs’ visual signals and their level of experience with dogs. For high-agreement, negative-valence videos, as prior education about dog body language increased, the Low-Experience group was paradoxically *more* likely to select “happy” and to provide more positive emotion ratings, while the reverse pattern was observed for all of the other groups. In other words, as learning increased, the interpretations of the Low-Experience group diverged from expert interpretations, while the interpretations of more-experienced individuals became more aligned with those of experts. This result suggests that direct experience with dogs is necessary in order to obtain the full effects of learning. It is also possible that the Low-Experience group was exposed to different, perhaps inaccurate, sources of information about dog body language compared to the other experience groups. Without more detailed information about the source of their education, this possibility cannot be eliminated. In addition, it is possible that the dog-experienced individuals who received education about dog body language may have had pre-existing interests in emotion perception that could have influenced their interpretations.

For the low-agreement, negative-valence videos, the effect of learning was only significant for Emotional Valence scores provided by the Owners and Prof<10 groups. These respondents’ interpretations became more negative as learning increased, while
ratings of the least and most experienced respondents (Low-Exp and Prof10+) were not predicted by the level of learning. The Low-Experience group may not have learned about the weakly-valenced behaviors in this set of videos, or they may simply have been unable to apply what they had learned without direct experience with dogs. In contrast, the Prof10+ group was more likely to have had direct experience with the viewed behaviors, and therefore, experience may have been more influential in their responses than learning.

For fearful categorizations, there were no significant interactions between learning and experience for any of the video sets. Experience, but not learning, significantly predicted fearful categorizations for most video sets. If the development of the perception of negative emotions is experience-dependent (see Chapters 1, 4 and 5), then direct exposure to fearful behavior may be important for the development of fear perception. As experience with dogs increases, individuals acquire greater exposure to dog behavior, including presumably a larger number and wider range of fearful behaviors. Education about dog body language without the benefit of direct experience may not suffice for the full development of interspecific fear perception.

Importantly, in line with analyses in Chapters 4 and 5 that demonstrated that the effect of experience was not due solely to education about dog behavior (e.g. analyses with behavior professionals excluded), there was a significant effect of experience on emotion ratings and categorizations in most analyses, even after controlling for the effect of learning and the interaction between learning and experience. For example, as found previously, more-experienced individuals were more likely than less-experienced
individuals to categorize high-agreement, positive-valence videos as happy and high-agreement, negative-valence videos as fearful, in line with expert evaluations.
CHAPTER 7

INTERSPECIFIC EXPERIENCE AND
OBSERVATIONAL FOCUS

Overview

In previous chapters, I presented results demonstrating that the interspecific
perception of emotion, particularly negatively-valenced emotion, may develop in an
experience-dependent manner. If interpretations of emotion vary among individuals with
different levels of dog experience, then their observational focus during the process of
interpretation might also vary. This topic is the focus of the current chapter.

Behavioral Categories

Respondents were asked to indicate which of a list of five behavioral categories
they used to interpret the emotions of the dog in each video. Multiple selections were
permitted. The average number of selections was 3.25 ($SD = 1.29$). When responses to
all videos were tabulated, the most commonly selected category was body movement
(78%), followed by facial expression (72%) and body position (63%). Head position
(57%) and head movement (55%) were the least commonly selected categories.

Body Parts

Respondents were also asked to indicate which of a list of five specific body parts
they used to interpret the dogs’ emotions. The average number of selections was 3.00
($SD = 1.19$). Across all videos, the most commonly selected body part was mouth (65%),
followed closely by tail (62%), ears (62%), and eyes (61%). Legs (50%) were the least commonly selected body part.

**Does Experience Predict the Number of Behavioral Categories and Body Parts Used by Observers?**

Linear mixed models were conducted on the number of behavioral categories and body parts selected by respondents, according to the procedures described in Chapter 4. Experience was a significant predictor of the number of behavioral categories and body parts that participants reported using to determine the dogs’ emotions, $F(3, 17150.97) = 216.42, P < .001$ and $F(3, 16336.22) = 348.59, P < .001$. The number of selections increased with experience (Figure 7-1), and all pairwise comparisons were significant.

![Figure 7-1. Mean number of selections by each experience group of behavioral categories and body parts used to interpret dogs' emotions. Sig. pairwise comparisons (Sidak-corrected): Low-Exp < Own < Prof<10 < Prof10+.](image-url)
Statistical Analyses of Categories Selected

Logistic regression with generalized estimating equations were conducted on respondents’ selections, according to the procedures described in Chapter 5. Separate models were run on each category with responses coded as 0 (non-selection) or 1 (selection). Since the number of selections increased with experience, the total number of behavioral categories or body parts selected by each participant was included as a covariate. Model-adjusted probabilities of category selection are displayed in figures. There were differences across the videos in the angles from which dogs were filmed, which could have influenced participants’ selections. Therefore, only comparisons of the experience groups on the full video set are presented below.

Does Experience Predict the Types of Behavior Observed?

All Videos

All participants. Selection of the body movement, body position, and head position categories did not vary by experience, Wald $X^2(3, N = 2163) = 5.63, P = .13$, Wald $X^2(3, N = 2163) = 3.45, P = .33$, Wald $X^2(3, N = 2163) = 3.81, P = .28$. However, experience was associated with selection of the head movement and facial expression categories, Wald $X^2(3, N = 2163) = 22.28, P < .001$ and Wald $X^2(3, N = 2163) = 47.15, P < .001$ (Figure 7-2). The Low-Experience and Owners groups were significantly less likely than professionals to select the facial expression category. In addition, the Low-Experience group was more likely to select the head movement category than any of the other experience groups. Experience remained a significant predictor of selection of the head movement and facial expression categories after controlling for the sex and age of
respondents, Wald $X^2(3, N = 2163) = 14.98, P = .002$, Wald $X^2(3, N = 2163) = 37.89, P < .001$.

![Figure 7.2][1]

**Figure 7-2.** Probability of selection of head movement and facial expression categories by experience group. Sig. pairwise comparisons (Sidak-corrected): Head move: Own, Prof<10, Prof10+ $<$ Low-Exp; Facial exp: Low-Exp, Own $<$ Prof<10, Prof10+.

**Behavior professionals excluded.** When behavior professionals were removed from the analysis, experience remained a significant predictor of selection of the head movement and facial expression categories, Wald $X^2(2, N = 1779) = 21.60, P < .001$ and Wald $X^2(2, N = 1779) = 20.39, P < .001$. The patterns of results remained the same.

**Owners only.** Within the Owners group, respondents who had owned five or more dogs were less likely to select head movement and more likely to select facial expression than their less-experienced peers, $OR = .80, CI = .71 – .91, P = .001$ and $OR = 1.36, CI = 1.15 – 1.60, P < .001$ (Figure 7-3). The number of dogs owned was not associated with selection of the other behavioral categories [body movement: $OR = 1.07$, $P = .38$; body position: $OR = .99, P = .91$; head position: $OR = .99, P = .83$].
Owners who interacted with three or more dogs per day were more likely to use facial expressions when interpreting the dogs’ emotions, \( OR = 1.30, CI = 1.10 – 1.53, P = .002 \). However, this variable was not associated with selection of the other categories [body movement: \( OR = 1.00, P = .99 \); body position: \( OR = .94, P = .32 \); head movement: \( OR = .91, P = .12 \); head position: \( OR = .99, P = .83 \)].

The daily number of hours that owners reported spending with their dogs was not significantly associated with any of the behavioral categories [body movement: \( OR = 1.00, P = .53 \); body position: \( OR = 1.01, P = .13 \); head movement: \( OR = .99, P = .07 \); head position: \( OR = 1.00, P = .92 \); facial expression: \( OR = 1.01, P = .08 \)]. However, there was a marginal effect for head movement and facial expression, such that the more time that owners spent with their dogs, the less likely they were to select head movement and the more likely they were to select facial expression.

**Does Experience Predict the Body Parts Observed?**
All Videos

**All participants.** Observation of all listed body parts varied by experience [eyes: \(Wald \chi^2(1, N = 2163) = 10.52, P = .02\), ears: \(Wald \chi^2(1, N = 2163) = 123.01, P < .001\), mouth: \(Wald \chi^2(1, N = 2163) = 20.37, P < .001\), legs: \(Wald \chi^2(1, N = 2163) = 112.08, P < .001\) and tail: \(Wald \chi^2(1, N = 2163) = 37.95, P < .001\).] The largest differences among the experience groups were found for selection of the ears category. The likelihood of selecting “ears” increased with experience, and all groups differed significantly, except for the two professional groups ([Figure 7-4](#)). Compared to the Low-Experience group, the odds of selecting “ears” were about three times higher in the Owners group (\(OR = 2.78, CI = 2.19 – 3.52, P < .001\)) and about four times higher in both professional groups (Prof<10: \(OR = 4.13, CI = 3.13 – 5.45, P < .001\); Prof10+: \(OR = 4.23, CI = 3.18 – 5.62, P < .001\)).

There were also large differences among the experience groups in selection of the legs and tail categories ([Figure 7-5](#)). Professionals were less likely to use these categories than less-experienced respondents. For example, the odds of selecting “legs” were more than three times higher (inverted \(OR\)) in the Low-Experience group than the Prof10+ group, and the odds of selecting “tail” were 1.6 times higher, \(OR = .30, CI = .23 - .39, P < .001\) and \(OR = .64, CI = .49 - .85, P = .002\).

Experience remained a significant predictor of selection of all body part categories after controlling for the sex and age of respondents [eyes: \(Wald \chi^2(1, N = 2163) = 16.87, P = .001\), ears: \(Wald \chi^2(1, N = 2163) = 91.19, P < .001\), mouth: \(Wald \chi^2(1, N = 2163) = 20.44, P < .001\), legs: \(Wald \chi^2(1, N = 2163) = 84.50, P < .001\) and
Figure 7-4. Probability of selection of eyes, ears, and mouth categories by experience group. Sig. pairwise comparisons (Sidak-corrected): Eyes: Own < Prof10+; Ears: Low-Exp < Own < Prof<10, Prof10+; Mouth: Own < all.

Figure 7-5. Probability of selection of legs and tail categories by experience group. Sig. pairwise comparisons (Sidak-corrected): Legs: Prof<10, Prof10+ < Own < Low-Exp. Tail: Prof10+ < Low-Exp, Own; Prof<10 < Own.
The general patterns of results remained the same.

**Behavior professionals excluded.** When behavior professionals were removed from the analysis, experience was no longer a significant predictor of selection of the eyes and tail categories, \( \text{Wald} \chi^2 (2, N = 1779) = 3.51, P = .17 \) and \( \text{Wald} \chi^2 (2, N = 1779) = 3.61, P = .16 \). However, the experience groups continued to vary in their use of the ears, mouth, and legs, \( \text{Wald} \chi^2 (2, N = 1779) = 86.93, P < .001 \), \( \text{Wald} \chi^2 (2, N = 1779) = 6.61, P = .04 \) and \( \text{Wald} \chi^2 (2, N = 1779) = 73.86, P < .001 \), and the patterns of results remained the same.

**Owners only.** Within the Owners group, respondents who had owned five or more dogs were more likely to select the eyes category and less likely to select mouth and legs than less-experienced owners, \( OR = 1.54, CI = 1.32 - 1.79, P < .001 \); \( OR = .87, CI = .76 - .99, P = .03 \); and \( OR = .83, CI = .72 - .96, P = .01 \). The number of dogs owned was not associated with the use of the ears and tail, \( OR = 1.07, P = .40 \) and \( OR = .90, P = .20 \).

Owners who interacted with three or more dogs per day were more likely to select the ears category and less likely to select legs, \( OR = 1.25, CI = 1.08 - 1.44, P = .003 \) and \( OR = .77, CI = .67 - .88, P < .001 \) (Figure 7-6). However, this variable was not significantly associated with use of the eyes, mouth, and tail, \( OR = 1.16, P = .06 \), \( OR = .96, P = .55 \), and \( OR = .94, P = .44 \).

The daily number of hours that owners reported spending with their dogs was only significantly associated with use of the ears, \( OR = 1.02, CI = 1.00 - 1.03, P = .02 \). The more time that owners spent with their dogs, the more likely they were to select the ears category. There was no significant association between the number of hours and the
other body part categories [eyes: $OR = 1.01, P = .17$; mouth: $OR = 1.00, P = .40$; legs: $OR = .99, P = .09$; and tail: $OR = .99, P = .42$].

**Discussion**

Results in previous chapters demonstrated that individual differences in experience are associated with differences in interspecific interpretations of emotion, supporting an experience-dependent hypothesis of the development of emotion perception. Here, I also found that the manner in which individuals assess dogs’ emotions varies by experience. First, those with greater levels of dog experience reported using more behavioral categories and body parts when interpreting the dogs’ emotions. This result could reflect a greater tendency, acquired with experience, to observe dogs more holistically. Second, the behavioral categories and body parts that respondents focused on varied according to their experience with dogs. When the number of selections was controlled, the use of facial expressions increased with experience in both
the owners-only and full-sample analyses, while the use of head movements decreased. In addition, more-experienced individuals tended to be more likely to observe the ears and less likely to focus on the legs and tail. These results suggest that more-experienced individuals have acquired an attention to the finer details of the face, rather than gross body movements and larger body parts. It is possible that less-experienced individuals may be less aware of dogs’ facial expressions and ear positions, while their attention to the tail could reflect the common belief that tail-wagging is associated with happiness in dogs.

Associations between observational focus and emotion recognition have been documented in research on human facial expression perception, especially in populations with psychiatric or developmental disorders. For example, a number of eye-tracking studies have found that autistic individuals, who tend to display impaired facial expression recognition, exhibit atypical face-scanning patterns (Bal et al., 2010; Chawarska & Shic, 2009; Kirchner, Hatri, Heekeren, & Dziobek, 2011; Pelphrey et al., 2002; Rutherford & Towns, 2008). In addition, individuals with schizophrenia tend to focus less on the features of the face (i.e. eyes, nose, mouth) than controls, and when they are trained to focus on these features, their emotion recognition improves (T. A. Russell, Green, Simpson, & Coltheart, 2008; Streit, Wölwer, & Gaebel, 1997). Research on interspecific emotion perception has also demonstrated a link between observational focus and emotion perception. Young children, who mistook aggressive dog faces as happy, tended to focus on the mouth, rather than the eyes, nose, and mouth (Meints, Allen, et al., 2010). Therefore, it is possible that the differences demonstrated here
among the experience groups in observational focus could explain differences in their perceptions of emotion.
CHAPTER 8
GENERAL DISCUSSION

Summary

The analyses presented in this dissertation suggest that interspecific emotion perception can develop in an experience-dependent manner. Individual differences in experience with dogs predicted ratings and categorizations of emotion in dogs by a large, diverse sample of adults. Participants included 152 individuals who had never owned a dog, 1,462 with dog-owning experience, 307 dog professionals with less than ten years of professional experience, and 242 professionals with ten or more years of experience. The effects of experience were generally larger for interpretations of behavior that had been judged by an initial expert panel as negatively-valenced than positively-valenced. Less-experienced individuals tended to provide more positive emotion ratings of behavior that had been expert-assessed as strongly negatively-valenced or as weakly-valenced. Less-experienced individuals were also more likely to diverge from experts in their emotion categorizations, selecting the happy, rather than fearful, category for behavior that had been assessed by experts as primarily fearful. In addition, there were interactions between experience with dogs and prior learning about dog body language. While education seemed to help more-experienced individuals provide categorizations that were more aligned with expert evaluations, the perceptions of individuals who had never owned a dog actually became less aligned. Lastly, differences among the experience groups in emotion ratings and categorizations were also reflected in differences in observational focus. Individuals with more experience were more likely to attend to the
dog’s facial expressions and ears, and less likely to attend to the legs and tail. They also attended to a greater number of features and behaviors than less-experienced individuals.

Strengths of the research included the large sample with variation in experience; the incorporation of multiple measures of experience in the survey and subsequent analyses; and the characterization and presentation of multiple stimulus types (i.e. video groupings). The wide range of dog experience found within the sample allowed for various means of assessing the effect of experience. Responses were analyzed according to broad experience categories (e.g. never owned a dog, owners, dog professionals), as well as experience-related subsets. For example, the Owners group was analyzed according to the total number of dogs owned in adulthood, the number of dogs interacted with daily, and the total time spent with one’s dogs daily. Effects on emotion perception were found using all experience-related measures. In addition, the initial expert evaluation of videos allowed for characterization of the video stimuli and selection of stimuli that could be grouped into subsets that were useful in subsequent analyses. The video groupings yielded patterns of results that were not evident when the videos were considered together. For example, analyses using the video groupings revealed that compared to more-experienced individuals, those who had never owned a dog did not distinguish as much between weakly positive and weakly negative emotional displays.

**How Do the Results Relate to Previous Research?**

Human facial expression recognition has also been shown to be sensitive to individual differences in experience. Abuse has been associated with increased sensitivity to angry faces, and even individual differences in mother-child attachment have been associated with emotion recognition (Bowen & Nowicki, 2007; Pollak, et al.,
In addition, consistent with theories of experience-dependent development, individual differences in experience need not occur in childhood to affect emotion recognition. Exposure to violent images in adulthood can influence emotion recognition, as can professional experience as a psychotherapist (Kirsh & Mounts, 2007; Kirsh, Olczak, & Mounts, 2006; Machado, Beutler, & Greenberg, 1999). Even the level of exposure between cultures, as measured by geographical distance and amount of telephone communication, is associated with accuracy in facial expression recognition across cultures (Elfenbein & Ambady, 2002, 2003). Thus, the recognition of facial expressions, among the most fundamental aspects of emotion perception, is vulnerable to individual differences in experience. The results of this dissertation extend the experience-dependent hypothesis to interspecific social cognition; individual differences in interspecific experience are associated with interspecific emotion perception.

Prior to the current research, previous research had found limited support for the experience-dependent development of interspecific emotion perception. There were strong effects of age in children’s interpretations of emotion in dog vocalizations and visual signals suggesting universal development. However, the effects of individual differences in experience with dogs were less evident. Neither visual experience (i.e. congenitally blind, late-blind, or sighted), nor experience with dogs, predicted accuracy in the decoding of dog barks (Molnár, et al., in preparation; Molnár, et al., 2010; Pongrácz, et al., 2006; Pongrácz, et al., 2005). In addition, Tami and Gallagher (2009) found only minimal effects of experience on interpretations of dog body language during dog-dog interactions. However, dog-dog interactions involve ritualized and exaggerated
behaviors whose emotional content can sometimes be difficult even for professionals to interpret, and the authors found significant individual differences in interpretations, regardless of the level of dog experience. In sum, previous studies on interspecific emotion perception were often focused on age, while the few studies that did include experience variables tended to find nonsignificant effects of experience or significant effects for only a small number of measures. The effects of experience may have been more evident in this dissertation due to aspects of the design, such as the video groupings and presentation of behavior outside of the context of dog-dog interactions.

The effects of experience on interpretations of dogs’ visual signals, but not vocalizations, could be explained by characteristics of animal vocalizations that are shared across species. Morton (1977) suggested that mammals’ motivational and affective states are associated with acoustic qualities of their vocalizations, such as tonality and frequency. He found evidence for basic structural-motivational rules of vocalizations in a variety of species, which would enable the listener to accurately interpret vocalizations without extensive direct experience with a particular species. Although there are similarities in facial expressions across species (Darwin, 1872/2009), visual signals and their interpretation may display greater variation across species than vocalizations, due to morphological differences. Therefore, direct experience with a species may be required in order to interpret its visual signals. For example, the position of the eyebrows is a strong indicator of fear in humans, and individuals viewing fearful facial expressions tend to focus on this area of the face (L. A. Sullivan & Kirkpatrick, 1996). In contrast, in dogs, the eyebrows may be difficult to observe due to the color and length of the hair, and viewers could thus be more successful interpreting fear in dogs by
focusing on other body parts. The position of the ears, for example, may be a more obvious indicator of fear in dogs (Simpson, 1997). My results suggest that dog-experienced individuals do indeed focus on the ears more than inexperienced individuals. Exposure to dogs displaying a variety of emotions and behaviors may facilitate the development of observational skills and increase the likelihood of focusing on species-appropriate features and behaviors.

**Interspecific Emotion Perception…In the Other Direction**

While some interspecific emotion perception research has focused on humans’ interpretations of emotion in dogs, other studies have focused on dogs’ responses to human emotional signals (Racca, Guo, Meints, & Mills, 2010). Communication between dogs and humans, whether the signaler is the dog or the human, is of research interest due to the dog’s unique relationship with humans and its advanced social cognitive abilities (Topál et al., 2009). Just as individual differences in humans’ experience with dogs appears to be associated with perception of emotion in dogs, individual differences in dogs’ experience with humans might also be associated with their perception of and response to human emotions.

In a separate study, I investigated dogs’ responses to human facial expressions and found that dogs varied their responses to facial expressions presented by the experimenter, a person they had just met, while they did not vary their responses to owner-presented expressions (Appendix G). Thus, the dogs' extensive experience with their owners paradoxically appeared to inhibit their behavioral regulation in response to the owners' expressions. The dogs' relationship with their owners may have superseded their sensitivity to the owners’ facial expressions, or the dogs may have simply
recognized that their owners were acting. Nevertheless, these results suggest that experience with a particular person’s expressions is not required for dogs to discriminate their expressions, just as humans do not need to have experience with a particular dog to interpret its emotions, suggesting that emotion perception is generalized across multiple members of a species.

In addition, in contrast to interspecific emotion perception in humans, there was no evidence for the experience-dependent development of interspecific emotion perception in dogs. Dogs' sensitivity to facial expressions was not associated with the length of dog-owner relationship, how their owners had acquired them, previous training history, length of daily dog-owner interaction, or owners' attachment to their dogs. However, it should be noted that humans’ range of experience with dogs is quite large, ranging from practically no dog experience to years of professional experience, while most dogs and certainly all of the dogs in the study had had extensive experience with humans. Therefore, in order to fully assess the experience-dependent hypothesis in dogs, it would be necessary to include dogs with atypical experiences with humans. The experiences could vary by quality or quantity. Free-ranging or feral dogs in rural areas, for example, might be good candidates for investigation due to their low levels of interaction with humans, although there could be safety issues involved with approaching and handling animals who are unaccustomed to contact with humans. Abused and neglected dogs could be another source of experiential variation. Just as abused children have displayed increased perceptual sensitivity to angry human facial expressions, it is possible that dogs with greater environmental exposure to angry human expressions could display increased sensitivity to these displays, as well.
Challenges of the Stimulus Set and Considerations for Future Research

As previously mentioned, researchers of human facial expression recognition have faced the challenge of creating and selecting emotional stimuli. They either produce their own stimuli or select stimuli from previously-validated sets. Two well-known sets of facial expression stimuli include Ekman’s Pictures of Facial Affect and the recently-validated NimStim set (Ekman & Friesen, 1976; Tottenham et al., 2009). Unfortunately, I am not aware of any previously-validated and publicly available sets of videos depicting emotion in dogs. Such a set would certainly have been useful for this dissertation.

I faced several challenges in the development of the stimuli. Since the videos were made available online, it was important to consider privacy issues for the owners of the dogs depicted. Since owners often consider dogs to be family members, owners may wish to provide consent for the recording and distribution of their dogs’ images. Therefore, only videos for which permission had been obtained were included in the current research. While one option would have been to create all of the videos myself, obtaining owner permission in the process, it was important to include a range of emotions, including fear, and there are ethical and practical issues involved with inducing fearful behavior in dogs. In addition, many owners could be uncomfortable with the recording and distribution of images of their dogs behaving in this manner. While filming at a shelter might seem like the next reasonable option, even unowned dogs can be considered temporarily “owned” by the shelters or rescue groups with whom they reside, and shelters can be highly protective of their dogs and sensitive to the possibility of negative impressions of their dogs. Given these difficulties, I was limited to assembling most of the stimulus set from a variety of acquaintances and behavior
professionals who provided permission for sharing their videos. After collecting 30 videos, I then characterized them with expert evaluations and selected the most appropriate subset for the public survey.

One of the disadvantages of assembling a stimulus set from various sources is that the stimuli are not standardized. There was variation among the videos in terms of the quality and length of the videos or the angles and distances from which the dogs were shown. This was not a problem for most analyses, since the same stimulus set was available to all experience groups. However, in order to avoid any potential biases based on particular features of individual videos, comparisons of responses by video grouping were not included in the analyses of observational focus. A larger set of standardized videos would be preferable in future studies so that the effects of experience on observational focus for different types of emotions can be more accurately assessed.

Expert categorizations of the high-agreement videos revealed that they perceived the dogs in these videos as mostly happy or fearful. While they and other participants utilized the “angry” and “sad” categories, these selections were less common. The most obvious explanation for these findings is that the behavior depicted in the stimulus set was more representative of happiness and fear in dogs than anger and sadness. Since participants of all experience groups believed that dogs could experience anger and sadness, it is less likely that participants were simply hesitant to classify dogs as angry or sad. It might be possible to include prototypical examples of anger in future studies. Offensive aggression, for example, might be considered angry behavior. Behavior could be characterized by using physiological indicators, as well as expert assessments.
Experts’ ratings of the low-agreement videos suggested that they were weakly-valenced versions of the high-agreement videos. Studies on human emotion recognition have also demonstrated that emotional expressions that are lower in intensity tend to be more difficult to judge and obtain lower agreement than high-intensity emotions (Gao & Maurer, 2009, 2010; Hess, Blairy, & Kleck, 1997). Thus, the expert ratings reflected typical emotion perception. However, it would have been preferable that the weakly-valenced videos be rated with high-agreement in order to compare them to high-agreement, strongly-valenced videos.

A more standardized video set might also include multiple examples of dogs of the same breed (or similar morphology). Perceptions of emotion in dogs of different breeds (or morphological features) could then be compared. These comparisons might reveal, for example, that owners of a particular breed interpret emotion in that breed differently than other owners or non-owners. In addition, experience with dogs possessing a particular ear or tail shape might influence the perception of emotion in such dogs.

A final, but important, limitation of using any stimulus set is that the results may not be generalizable to other videos or to live behavior. While an effort was made to include a diverse range of behaviors, breeds, and situations, there are aspects of live behavior (e.g. eye contact between dog and observer, contextual cues) which cannot be replicated in a video, and thus, it is possible that the effects of experience on interspecific interpretations might be muted by the richness of live behavior. However, to the extent that real-world situations can also provide incomplete information and require split-
second decisions (e.g. loose dog approaches a person out for a walk), I believe that my results may still be applicable in the real world.

**The Use of Experts**

Like other studies exploring interpretations of dog visual signals, the dissertation research included the use of behavioral assessments by experts (Lakestani, 2007; Lakestani et al., 2006; Tami & Gallagher, 2009). However, there are potential drawbacks to this approach. First, as discussed in the introduction, reliance on a single indicator of emotion or a single class of indicators (e.g. physiological, behavioral, cognitive) can lead to incomplete information about a human or animal’s emotional state. The initial expert panel and participants provided interpretations of emotion in dogs based on behavioral cues alone (as would be done in typical encounters with dogs), and physiological indicators of emotion in the focal dogs were not assessed. It should be noted, however, that the experts described specific behaviors, such as lip-licking, panting, and low tail, in videos that they assessed as negatively-valenced (Table 2-1), and these behaviors have been associated with fear in dogs in previous studies that incorporated both physiological and behavioral measures (Beerda et al., 1998; Ogata et al., 2006). In addition, the focus of the research was on perceptions of emotions, which need not reflect the dogs’ “true” emotional state. However, to the extent that the initial expert evaluations could be considered more accurate indicators of the dogs’ emotional states than the interpretations of less-experienced individuals, the limitations of determining emotion based on behavioral cues alone should be kept in mind. Future production of standardized video stimuli could incorporate the use of physiological measures to support expert evaluations.
Another potential drawback of the use of expert evaluations is that variation among the unique experiences and qualifications of different types of behavior professionals could influence behavioral interpretations. For example, a board-certified veterinary behaviorist (DACVB) is a veterinarian who has completed an internship and residency specializing in behavior, conducted research, published a scientific paper, written three peer-reviewed case reports, and passed an examination. A certified applied animal behaviorist (CAAB) has received a doctorate in a biological or behavioral science with an emphasis on animal behavior, demonstrated original interpretations of animal behavior information, and acquired at least five years of professional experience. A certified pet dog trainer (CPDT-KA) has acquired at least 300 hours of experience in dog training, as well as passed an examination on instruction skills, ethology, learning theory, and other topics. Due to variation in the experiences and education of different types of behavior professionals, including potential differences in the behavior of dogs seen in their applied work, it is possible that their interpretations of behavior could differ, as well. The initial expert panel included all of the professionals mentioned above to avoid potential biases from one particular type of expert. However, further work is needed to determine whether variation in professional behavioral experience leads to variation in interpretations of behavior.

**Additional Suggestions for Future Directions**

In addition to more standardized video stimuli, future research could also directly investigate the effect of education about dog body language on perceptions of emotion. A short online training module about canine visual signals, including pre-assessed examples of fearful, happy, or other behavior, could be developed and administered with
pre- and post-tests. In addition, a thorough assessment of prior knowledge about dog body language, as well as sources of this prior knowledge, would be necessary. Informal sources of education, such as television shows, could then be distinguished from more formal or professional sources of education. The effects of the intervention could be compared among individuals with different levels of experience with dogs. In line with the current results, the training would be expected to change perceptions the most in less-experienced groups, while prior experience with dogs would be more influential in the high-experience groups.

A few intervention studies have been conducted, primarily as part of bite prevention efforts, and have yielded promising results. For example, a ten-minute training for three-to-five year-olds about recognizing emotion in dogs improved the children’s accuracy, though effectiveness was reduced at a two-week follow-up (Lakestani, 2007). This type of intervention may also have broader implications for participants’ social skills. Children and adults who received interspecific emotion recognition training not only improved their recognition of emotion in dogs, but also in humans (Stetina et al., 2011). Interestingly, the latter finding suggests that interspecific and intraspecific emotion recognition skills may be associated within individuals, providing evidence for a single emotion-processing system that is applied to both interspecific and intraspecific situations.

Most glaringly, there is a need for increased inquiry into the plasticity and development of neural networks involved in emotion. Fortunately, there are many affective neuroscientists currently engaged in such work (e.g. Fu et al., 2008; Monk et al., 2008; Phillips, Ladouceur, & Drevets, 2008; Tully & Bolshakov, 2010). A detailed
understanding of the cellular mechanisms of experience-expectant and experience-dependent development is required. Some have suggested that experience-expectant processes occur through pruning and refinement of existing synaptic connections, while experience-dependent development occurs through establishment of new connections (e.g. Greenough, et al., 1987). However, these models can only be hypothetically applied to socioemotional development without further investigation.

**Implications**

In sum, interspecific emotion perception using dogs’ visual signals was found to be associated with individual differences in experience with dogs, providing support for the experience-dependent hypothesis of emotional development. There were striking similarities between intraspecific and interspecific emotion perception. For example, experience is less influential in the perception of happiness than fear whether the emotion presenter is a human or dog. Even the dimensional and categorical theories of emotion appeared to be valid in the interspecific context. These fundamental similarities suggest that the neural networks of emotion and the development of these networks in an intraspecific context can be applied flexibly to interspecific situations. However, while it is difficult to measure or control humans’ social experiences and exposure to emotional information from other humans, it is less difficult to gauge humans’ exposure to dogs. At the least, there is a broader range of interspecific experience than intraspecific experience that begs for further exploration. Interspecific investigations are therefore an important new avenue for the investigation of fundamental social cognitive skills like emotion perception.
In addition, observers’ interspecific experience should be taken into consideration when evaluations are made of dogs’ behavior in applied or research contexts. Whether observers are non-dog-owners, owners, behavior professionals, or researchers, their level of experience with dogs could play a role in their interpretations of dog behavior. Less-experienced individuals in particular should be aware of potential deficits in their “dog-reading” ability when interacting with dogs. In research that involves behavioral observations, such as behavior genetics and veterinary behavioral studies, possible effects of observers’ experience with dogs should be accounted for in data analysis or controlled in the design of the study. While many studies include definitions of behaviors to be observed, which may appear to be objective and less susceptible to the effects of experience, it cannot be assumed that differently-experienced observers presented with the same behaviors will produce the same observations. Therefore, in both applied and research situations, it will be additionally important to consider observers’ experience with dogs and to assess interobserver reliability, especially where there may be health or safety consequences for humans or dogs.
REFERENCES


APPENDIX A

SURVEY

About You

1. Your first name
   ______________________________________________

2. Your last name
   ______________________________________________

3. Street address
   ______________________________________________

4. City (This information is being collected so that we may determine the geographical range of participation.)
   ______________________________________________

5. State
   ______________________________________________

6. Zip Code
   ______________________________________________

7. Country
   ______________________________________________

8. Would you be interested in receiving an invitation to participate in a related study?
   (You are not obligated to participate if you select "yes.")
   ( ) Yes
   ( ) No
9. E-mail address (This is the address we will use if you request to receive results.)

____________________________________________

10. Phone number

____________________________________________

11. Your sex
   ( ) Male
   ( ) Female

12. Your age

____________________________________________

13. Total number of adults (18 and up) in your household, including yourself

____________________________________________

14. Total number of children in your household

____________________________________________

15. Total number of dogs in your household

____________________________________________

16. What type of setting do you live in?
   ( ) Urban
   ( ) Suburban
   ( ) Rural

17. Please select "true" or "false" for each of the following statements. (Questions created through a partnership between PetSmart and Suzanne Hetts, Ph.D. of Animal Behavior Associates, Inc. Used with permission.)

When a dog yawns, I know he's relaxed and enjoying himself.

When a dog wags his tail, I know he wants to be friendly.
If a dog holds himself quite still and stiff while being petted, that's a sign that he doesn't like the interaction.

A dog knows he's done something wrong if he looks guilty afterwards.

When a dog stares at people he's meeting for the first time, it's because he's looking into their eyes to tell if he can trust them.

When a dog flicks his tongue out and quickly licks his nose, it's because he may be stressed.

About Your Dog

If you have more than one dog, please complete the following questions about the dog that you have had for the longest time. If you participated in the in-person study, please complete this page about the dog that you participated with.

18. Your dog's name

____________________________________________

19. Your dog's birthdate in MM/DD/YYYY format. Please provide estimate if unknown.

____________________________________________

20. Your dog's sex
   ( ) Male
   ( ) Female

21. Has your dog been spayed or neutered ("fixed")?
   ( ) Yes
   ( ) No

22. How old was your dog when s/he was spayed or neutered ("fixed")?
   ( ) Younger than 6 months
   ( ) 6-12 months
   ( ) Older than 12 months
   ( ) Unsure

23. Is your dog a purebred?
24. Is your dog registered with a nationally-recognized kennel club, such as the AKC?
   ( ) Yes
   ( ) No
   ( ) Unsure

25. What breed is your dog? If mixed-breed, please write "mix" and indicate the breeds present, if known.

   ______________________________________________

26. What is your reason for having this dog? Check all that apply.
   ( ) Pet
   ( ) For breeding
   ( ) For competitions
   ( ) For protection
   ( ) Other

27. When did you get your dog (MM/DD/YYYY)? Please provide estimate if unknown.

   ______________________________________________

28. Where did you get your dog from?
   ( ) Breeder
   ( ) Pet store
   ( ) Shelter or rescue group
   ( ) Friend or relative
   ( ) Self - I am a breeder.
   ( ) Other

29. What formal training (e.g. with a professional trainer) has your dog received? Check all that apply.
   ( ) None
   ( ) Basic manners and obedience
   ( ) Competitive obedience
   ( ) Agility
   ( ) Conformation
   ( ) Rally
   ( ) Therapy
30. Please describe any patterns of behavior in your dog that you see as a problem. If not applicable, please write "none."

31. What do you do when your dog does something that you don't like? Of the following common responses, check all that apply.
   - "No" or other verbal reprimand
   - Stare him/her down
   - Growl at him/her
   - Physical correction
   - Time-out
   - Ask him to do something else
   - Distract him with food or toys
   - Ignore the behavior
   - Other

32. On the average weekday, how much time do you spend with your dog, not including the hours that you spend sleeping?

____________________________________________

33. On the average weekday, how long do you exercise your dog (take him/her for a walk or run, play fetch, etc.)?

____________________________________________

34. Where do you primarily keep your dog during the day?
   - Outdoors
   - Indoors

35. Where does your dog primarily sleep at night?
   - Outdoors
   - Indoors - My Bedroom
   - Indoors - Other

36. Please tell us to what extent the following statements are true about your dog. (Adapted from Skuse et al., 1997.) (Never true of my dog, Rarely true of my dog, Sometimes true of my dog, Often true of my dog, Always true of my dog)

Lacks an awareness of people's feelings
Does not realize when people are upset or angry

Is oblivious to the effect of his/her behavior on members of the family

Behavior often disrupts normal family life

Very demanding of people's time

Does not pick up on body language

Your Feelings About Your Dog

37. Please tell us whether you agree or disagree with some very brief statements about your dog. For each statement, check whether you strongly agree, somewhat agree, somewhat disagree, or strongly disagree. You may refuse to answer. (Johnson, Garrity & Stallones, 1992)

My dog means more to me than any of my friends.

Quite often I confide in my dog.

I believe that dogs should have the same rights and privileges as family members.

I believe my dog is my best friend.

Quite often, my feelings toward people are affected by the way they react to my dog.

I love my dog because s/he is more loyal to me than most of the people in my life.

I enjoy showing other people pictures of my dog.

I think my dog is just a dog.

I love my dog because s/he never judges me.

My dog knows when I'm feeling bad.

I often talk to other people about my dog.

My dog understands me.
I believe that loving my dog helps me stay healthy.

Dogs deserve as much respect as humans do.

My dog and I have a very close relationship.

I would do almost anything to take care of my dog.

I play with my dog quite often.

I consider my dog to be a great companion.

My dog makes me feel happy.

I feel that my dog is a part of my family.

I am not very attached to my dog.

Owning a dog adds to my happiness.

I consider my dog to be a friend.

--------------------------------------------------------------------------
About Your Experience with Dogs
--------------------------------------------------------------------------

38. What is your experience with dogs? Check all that apply.
   ( ) None
   ( ) I have interacted with dogs only occasionally throughout my life and never had a dog.
       ( ) I had a dog as a child (<18 yrs old).
       ( ) I've had a dog as an adult (age 18 and up).
       ( ) I've worked with dogs professionally.
       ( ) Other

39. How long (in years) have you worked with dogs professionally?
   ________________________________________________________________

40. What types of work have you done with dogs? Check all that apply.
   ( ) Dog behavior professional (e.g. trainer, behaviorist)
   ( ) Veterinarian or veterinary technician not specializing in behavior
   ( ) Dog walker or sitter
( ) Dog groomer
( ) Dog daycare or boarding facility technician or other employee
( ) Other

41. On the average day, how many dogs do you interact with (walk, play, groom, pet, etc.)? Include your own dog/s if relevant.

____________________________________________

42. How many times in your adult life (18 and up) have you received a bite from a dog that resulted in bleeding?

____________________________________________

43. What is the total number of dogs that you have had as an adult (age 18 and up)? Include your current dogs.

____________________________________________

44. Please list each breed of dog that you have had as an adult and the number of dogs from each breed, including your current dogs. For mixed-breeds, write "mix" and the breeds present, if known.

45. I am good at figuring out how a dog is feeling by watching what s/he is doing.
   ( ) 1
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9

46. How have you learned to interpret the body language of dogs? Check all that apply.
   ( ) Not applicable - I never formally learned about dog body language.
   ( ) I read a book or article that explained dog body language.
   ( ) I attended a lecture or seminar that explained dog body language.
   ( ) I watched a video that explained dog body language.
   ( ) A behavior professional (e.g. trainer) explained dog body language to me.
   ( ) I learned from working with dogs professionally.
   ( ) Other
In the next section, you will be presented with 8 short video clips of dogs (without sound) and with questions after each video.

Interpretations of Emotion

Please click on the video below to view it. Then, answer the questions that follow. We are interested in your interpretation of the video. There are no right or wrong answers.

47. Which word do you think best describes how the dog was feeling?
   ( ) angry
   ( ) happy
   ( ) neutral
   ( ) fearful
   ( ) sad

48. How well does the word you selected above fit the dog's feelings?
   ( ) 1
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9

49. If there is a word that better describes the dog's feelings, please write it here (one word only):
   ____________________________________________

50. How safe/unsafe would it have been to approach this dog?
   ( ) 1 unsafe
   ( ) 2
   ( ) 3
   ( ) 4
51. What type of emotion was the dog primarily feeling?

( ) 1 negative
( ) 2
( ) 3
( ) 4
( ) 5 (neutral)
( ) 6
( ) 7
( ) 8
( ) 9 positive

Please rate how the dog was feeling on each of the following dimensions. The dog may have shown any number of feelings.

52.

( ) 1 excited
( ) 2
( ) 3
( ) 4
( ) 5 (neutral)
( ) 6
( ) 7
( ) 8
( ) 9 calm

53.

( ) 1 tense
( ) 2
( ) 3
( ) 4
( ) 5 (neutral)
( ) 6
( ) 7
( ) 8
( ) 9 loose
54. ( ) 1 relaxed
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9 stressed

55. ( ) 1 unhappy
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9 happy

56. ( ) 1 cheerful
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9 sad

57. ( ) 1 peaceful
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
58. ( ) 1 bold
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9 fearful

59. Which of the following types of behavior told you how the dog was feeling? (multiple selections permitted)
   ( ) Facial expression
   ( ) Head position
   ( ) Head movement
   ( ) Body position
   ( ) Body movement

60. Which of the following parts of the dog told you how s/he was feeling? (multiple selections permitted)
   ( ) Eyes
   ( ) Ears
   ( ) Mouth and tongue
   ( ) Legs and paws
   ( ) Tail

61. What specific behaviors told you how the dog was feeling? (You don't have to use the entire space, and phrases are okay.)

62. How difficult/easy was it to figure out how this dog was feeling?
   ( ) 1
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
63. How accurate/inaccurate do you think your answers were about this dog?
   ( ) 1
   ( ) 2
   ( ) 3
   ( ) 4
   ( ) 5 (neutral)
   ( ) 6
   ( ) 7
   ( ) 8
   ( ) 9

64. Do you think this is a purebred or mixed-breed dog?
   ( ) Purebred
   ( ) Mixed-breed ("mutt")

==============================================================================
Likeliness Ratings
==============================================================================

How likely/unlikely do you think it is that dogs experience each of the following emotions?
1 (very unlikely) 2 3 4 5 (neutral) 6 7 8 9 (very likely)
happiness
anger
fear
sadness
disgust
surprise
love
frustration
excitement
guilt

==============================================================================
Works Cited in Survey
==============================================================================

APPENDIX B

INTERSPECIFIC EXPERIENCE AND
DESCRIPTIONS OF BEHAVIOR

Overview

In Chapter 7, differences among the experience groups were found in selections of behavioral categories and body parts observed during interpretations of dogs’ emotions. Here, I investigate participants’ written descriptions of observed behavior. In an open-ended question, participants were asked to describe the behaviors that helped them interpret each dog’s emotions (see Table B-1 for examples). If interspecific emotion perception develops in an experience-dependent manner, then the experience groups should vary in their descriptions.

Table B-1. Examples of open-ended responses from each experience group for a high-agreement, positive-valence video (#2) and a high-agreement, negative-valence video (#5).

<table>
<thead>
<tr>
<th>Video ID</th>
<th>Experience group</th>
<th>Response</th>
</tr>
</thead>
</table>
| 2        | Low-Experience   | "It moved around a lot and was sniffing a lot like it was very excited and wanted to do something."
|          | Owners           | "tail was wagging, licked person, panting and running around as if curious about the person" |
|          | Prof<10          | "wagging tail, jumping up to lick, loose back end" |
|          | Prof10+          | "head low, body wagging, body held low to the ground, licking person's face" |
| 5        | Low-Experience   | "No movement" |
|          | Owners           | "lack of movement, sad look in eyes" |
|          | Prof<10          | "closed mouth, watchful gaze" |
|          | Prof10+          | "the tension in the face and body, the harder eyes and closed tight mouth" |

Text Analysis Methodology

The Linguistic Inquiry and Word Count (LIWC) program was used for analysis of answers to the open-ended question. The program is commonly used for text analysis in psychology studies and counts the use of words in categories provided by the LIWC dictionary, as well as user-defined dictionaries (Pennebaker, et al., 2003; Tausczik & Pennebaker, 2010).
Not all categories from the LIWC dictionary were relevant to the current research (e.g. Work, Religion) and were not included in the analyses. The following categories were included: Negative Emotion, Positive Emotion, Perceptual Processes, Motion, Space, and Time. The subcategories of Perceptual Processes (See, Hear, and Feel) were also included. Table B-2 displays examples of words from each category, as well as the number of words defined by the LIWC dictionary in each category.

Table B-2. LIWC dictionary categories, examples of words in each category, and number of words in each category.

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
<th>Number of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive emotion</td>
<td>Love, nice, sweet</td>
<td>406</td>
</tr>
<tr>
<td>Negative emotion</td>
<td>Hurt, angry, nasty</td>
<td>499</td>
</tr>
<tr>
<td>Motion</td>
<td>Walk, move, shake</td>
<td>168</td>
</tr>
<tr>
<td>Space</td>
<td>Down, in, wide</td>
<td>220</td>
</tr>
<tr>
<td>Time</td>
<td>End, until, constantly</td>
<td>239</td>
</tr>
<tr>
<td>Perceptual processes</td>
<td>Observing, heard, feeling</td>
<td>273</td>
</tr>
<tr>
<td>See</td>
<td>View, saw, seen</td>
<td>72</td>
</tr>
<tr>
<td>Hear</td>
<td>Listen, hearing</td>
<td>51</td>
</tr>
<tr>
<td>Feel</td>
<td>Feels, touch</td>
<td>75</td>
</tr>
</tbody>
</table>

In addition to the internal LIWC dictionary, a unique “dog dictionary” was created based on responses to the open-ended question. A second text analysis program called TextStat was used to create a list of word frequencies from the entire corpus of textual responses. Words that were used 100 or more times were examined for inclusion in the dog dictionary. Function words, such as pronouns, articles, and prepositions, were excluded. The most common dog-related words were then examined and categorized into “dog body part” words and “dog action” words. Each of these categories was further divided into “head” and “body” words. Table B-3 displays a list of words in the dog dictionary and the categories with which they were associated. Finally, categorical analysis with the “dog dictionary” was conducted using the LIWC program.
Table B-3. **Words in dog dictionary and category assignments.** Variants of words (e.g. plural, tense) were included in the dictionary, but are not listed below for brevity.

<table>
<thead>
<tr>
<th>Word</th>
<th>Parts</th>
<th>Actions</th>
<th>Body</th>
<th>Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>tail</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>belly</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>leg</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>paw</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>ear</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>eye</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<td>eyebrow</td>
<td>X</td>
<td></td>
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<td>eyelid</td>
<td>X</td>
<td></td>
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<td>eyeball</td>
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<td></td>
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<td>X</td>
</tr>
<tr>
<td>nose</td>
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<td></td>
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<td>nostrils</td>
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<td>mouth</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>teeth</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>lip</td>
<td>X</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>tongue</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>playbow</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>wag</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>tuck</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>bark</td>
<td>X</td>
<td></td>
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<td>X</td>
</tr>
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<td>lick</td>
<td>X</td>
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<td>X</td>
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<td>pant</td>
<td>X</td>
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<tr>
<td>sniff</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>bite</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>flick</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Overall Use of Dog Dictionary Words**

Linguistic category use in open-ended responses to all videos was tabulated. 61% of responses included the names of dog body parts, while 52% included words relating to dogs’ actions. 60% of the responses included words relating to the head in particular, while 40% included words associated with other parts of the body.

**Overall Use of LIWC Internal Dictionary Words**
A majority (62%) of responses included words relating to perceptual processes, such as sight and hearing. Spatial words were also popular (64%), while motion (44%) and time words (39%) were found in less than half of the responses. A slightly larger proportion of responses (39%) included positive emotion words than negative emotion words (30%).

**Statistical Analyses of Linguistic Categories**

Linear mixed models were conducted on the word count of each textual response, according to the procedures described in Chapter 4. Logistic regression with generalized estimating equations was conducted on respondents’ use of linguistic categories, according to the procedures described in Chapter 5. Separate models were run on each linguistic category with binary-coding for each response (0 = category absent, 1 = category present). Due to differences across the videos in the angles from which the dogs were filmed, comparisons of the experience groups on the full video set are presented below. The results for the dog dictionary are presented first, followed by results for the internal LIWC dictionary.

**Does Experience Predict Word Use in Descriptions of Observed Behavior?**

**Word Count**

Experience was a significant predictor of word count, $F(3, 14000.50) = 2.99$, $P = .03$. Responses tended to become shorter as experience increased (Figure B-1).

**Dog Dictionary**

**All participants.** Experience was a significant predictor of usage of words referring to dog body parts and dog actions, $Wald \chi^2(3, N = 2163) = 117.72$, $P < .001$ and $Wald \chi^2(3, N = 2163) = 72.96$, $P < .001$ (Figure B-2). Experience was also associated
Figure B-1. Average word count by experience group. Sig. pairwise comparisons (Sidak-corrected): Prof10+ < Own.

Figure B-2. Probability of usage of dog dictionary categories for each experience group. Sig. pairwise comparisons (Sidak-corrected): Parts: Low-Exp < Own < Prof<10, Prof10+; Actions: Low-Exp < Own < Prof<10, Prof10+. 
with the usage of words relating specifically to the body and head of the dog, $Wald \chi^2(3, N = 2163) = 41.96, P < .001$ and $Wald \chi^2(3, N = 2163) = 155.31, P < .001$ (Figure B-3). The use of all categories tended to increase with experience, with a nonsignificant decrease from the Prof<10 to Prof10+ group. The largest differences among the experience groups occurred for the “head” category. The odds of using head-related words were more than 2.5 times higher for the Prof10+ group than the No-Experience group.

![Figure B-3. Probability of usage of dog dictionary categories for each experience group. Sig. pairwise comparisons (Sidak-corrected): Body: Low-Exp < all, Own < Prof<10; Head: Low-Exp < Own < Prof<10, Prof10+.](image)

Experience remained a significant predictor of usage of all categories after controlling for the sex and age of respondents [parts: $Wald \chi^2(3, N = 2163) = 107.27, P < .001$; actions: $Wald \chi^2(3, N = 2163) = 71.14, P < .001$; body: $Wald \chi^2(3, N = 2163) = \ldots$]
46.38, \( P < .001 \); head: \( \chi^2(3, N = 2163) = 140.00, P < .001 \]. The general patterns of results remained the same.

**Behavior professionals compared to other professionals.** Behavior professionals were more likely than other dog professionals to use words referring to the parts of a dog, as well as its actions, \( OR = 1.57, CI = 1.23 - 2.01, P < .001 \) and \( OR = 1.44, CI = 1.17 - 1.78, P = .001 \]. In addition, they were more likely to use words from the “head” category, but there was no difference for the “body” category, \( OR = 1.85, CI = 1.46 - 2.34, P < .001 \) and \( OR = 1.11, P = .38 \].

**Behavior professionals excluded.** When behavior professionals were removed from the full sample for analysis, experience remained a significant predictor of usage of all dog dictionary categories [parts: \( \chi^2(2, N = 1779) = 37.26, P < .001 \]; actions: \( \chi^2(2, N = 1779) = 20.06, P < .001 \); body: \( \chi^2(2, N = 1779) = 23.53, P < .001 \); head: \( \chi^2(2, N = 1779) = 25.85, P < .001 \]. The patterns of results remained the same.

**Owners only.** The number of dogs owned and the daily number of hours that owners spent with their dogs was not significantly associated with usage of the dog dictionary categories. However, owners who interacted with three or more dogs per day were more likely to use words from the “head” category in their descriptions, \( OR = 1.20, CI = 1.06 - 1.36, P = .005 \].

**LIWC Dictionary**

**All participants.** In addition, experience was found to be significantly associated with the use of linguistic categories from the LIWC dictionary. For example, experience was associated with the use of negative emotion words, but not positive emotion words,
Wald $X^2(3, N = 2163) = 66.00, P < .001$ and Wald $X^2(3, N = 2163) = 3.52, P = .32$ (Figure B-4). Experience was also a significant predictor of usage of “perceptual” words, Wald $X^2(3, N = 2163) = 120.58, P < .001$, as well as the subcategories “see,” “hear,” and “feel,” Wald $X^2(3, N = 2163) = 179.43, P < .001$, Wald $X^2(3, N = 2163) = 171.47, P < .001$, and Wald $X^2(3, N = 2163) = 70.00, P < .001$ (Figure B-5). Lastly, experience was associated with the use of motion-, space-, and time-related words, Wald $X^2(3, N = 2163) = 15.98, P = .001$, Wald $X^2(3, N = 2163) = 22.32, P < .001$, and Wald $X^2(3, N = 2163) = 70.00, P < .001$ (Figure B-6). Compared to the Owners and Low-Experience groups, the professional groups were more likely to use all categories except “motion.”

Figure B-4. Probability of usage of LIWC dictionary categories for each experience group. Sig. pairwise comparisons (Sidak-corrected): Neg emotion: Low-Exp, Own < Prof<10, Prof10+. 
Figure B-5. Probability of usage of LIWC dictionary categories for each experience group. Sig. pairwise comparisons (Sidak-corrected): See: Low-Exp, Own < Prof<10, Prof10+; Hear: Low-Exp < Own < Prof<10, Prof10+; Feel: Low-Exp, Own < Prof<10, Prof10+.

Figure B-6. Probability of usage of LIWC dictionary categories for each experience group. Sig. pairwise comparisons (Sidak-corrected): Motion: Own < Low-Exp. Space: Low-Exp < Prof<10, Prof10+; Own < Prof<10. Time: Low-Exp < Own < Prof<10, Prof10+. 
The largest differences among the experience groups were observed for words from the “hear” category. When compared to the Low-Experience group, the odds of using words from this category were about 3 times higher in the Owners group, 6 times higher in the Prof<10 group, and 5 times higher in the Prof10+ group. Follow-up analyses indicated that most of the effect was due specifically to the use of the words “ear” and “ears.”

**Behavior professionals compared to other professionals.** Behavior professionals and other dog professionals did not vary significantly in their use of positive emotion words, \( OR = 1.02, CI = .83 – 1.25, P = .86 \). However, behavior professionals were marginally more likely to use negative emotion words, \( OR = 1.19, CI = .98 – 1.45, P = .08 \). In addition, they were significantly more likely to use perceptual words, as well as words relating to motion, space, and time, \( OR = 1.66, CI = 1.33 – 2.08, P < .001 \); \( OR = 1.24, CI = 1.04 – 1.49, P = .02 \); \( OR = 1.27, CI = 1.03 – 1.56, P = .03 \); and \( OR = 1.23, CI = 1.01 – 1.50, P = .04 \).

**Behavior professionals excluded.** When behavior professionals were removed from the full sample for analysis, usage of words from the “space” category was no longer significantly associated with experience, \( Wald \chi^2(2, N = 1779) = 3.11, P = .21 \). However, experience remained a significant predictor of the other linguistic categories [neg emotion: \( Wald \chi^2(2, N = 1779) = 17.57, P < .001 \); perceptual: \( Wald \chi^2(2, N = 1779) = 22.42, P < .001 \); motion: \( Wald \chi^2(2, N = 1779) = 12.97, P = .002 \); time: \( Wald \chi^2(2, N = 1779) = 15.69, P < .001 \)].

**Owners only.** Owners who had owned five or more dogs were more likely than less-experienced owners to use words from the positive emotion and negative emotion
categories, $OR = 1.20, CI = 1.07 – 1.35, P = .003$ and $OR = 1.14, CI = 1.01 – 1.29, P = .04$. In addition, the daily number of hours that owners spent with their dogs was positively associated with the use of both positive and negative emotion words, $OR = 1.02, CI = 1.01 – 1.03, P = .001$ and $OR = 1.02, CI = 1.01 – 1.03, P = .004$. Lastly, owners who interacted with three or more dogs per day were more likely to use words from the positive emotion, perceptual processes, space, and time categories; $OR = 1.17, CI = 1.04 – 1.31, P = .009$; $OR = 1.19, CI = 1.05 – 1.34, P = .005$; $OR = 1.17, CI = 1.05 – 1.31, P = .005$; and $OR = 1.13, CI = 1.01 – 1.26, P = .04$.

**Discussion**

Analyses of respondents’ open-ended descriptions of the dogs’ behavior revealed the greatest differences among the experience groups in the usage of words associated with the head of the dog, negative emotions, perceptual processes, and time. The probability of using these linguistic categories increased with experience, even though the length of responses decreased. Furthermore, analyses within the Owners group supported the effect of experience on the use of these linguistic categories.

Analyses in Chapter 7 on respondents’ selections of behavioral categories and body parts had suggested that individuals with greater dog experience attend to the finer details of a dog’s body, such as the ears, when interpreting emotion in dogs. The results reviewed here offered additional support for this suggestion. While the usage of words from all of the “dog dictionary” categories increased greatly with experience, the largest increase was observed for head-related words (e.g. “ears,” “eyes”). Furthermore, the use of words from the perceptual processes category, as well as the subcategories related to seeing, hearing, and feeling, increased with experience. One can easily understand how
attention to the dog’s head might also be associated with attention to its perceptual processes.

The results also suggested that more-experienced individuals were much more likely to use words associated with time. This category included words relating to relative relationships in time (e.g. “while,” “next”), speed (e.g. “slowly”), and frequency (e.g. “repeatedly”). Increased use of these words among more-experienced respondents could indicate, on the one hand, greater attention to the details of the dogs’ actions (e.g. “walked slowly” instead of “walked”), or on the other hand, greater descriptive abilities. More-experienced individuals may have had previous practice with writing about dog behavior and discussing dog behavior in a detailed manner.

The results of Chapters 4 and 5 had suggested that the effect of dog experience was less evident for the perception of positive than negative emotions. Here, too, there was no difference among the experience groups in the use of positive emotion terms in descriptions of the dogs’ behavior, while the use of negative emotion terms increased with experience. Just as more-experienced respondents were more likely to categorize dogs as fearful and to provide more negative emotion ratings, they were also more likely to use negative emotion words in their written descriptions.

The differences among the experience groups in descriptions of observed behavior support the suggestion made in Chapter 7 that observational focus varies by experience and could underlie differences in emotion ratings and categorizations.
APPENDIX C

INTERSPECIFIC EXPERIENCE AND RATINGS OF DIFFICULTY AND ACCURACY

Difficulty and Accuracy Rating Scales

Across all videos, the average difficulty rating was 3.35 ($SD = 2.06$) on a nine-point scale (1 = very easy, 9 = very difficult). “2” was the most common rating, indicating that in general, respondents believed that it was easy to interpret the dogs’ emotions. In addition, respondents tended to believe that their interpretations were accurate, providing an average rating of 6.47 ($SD = 2.03$) with a mode of “8” (1 = very inaccurate, 9 = very accurate).

Figure C-1 displays unadjusted mean difficulty and accuracy ratings for each of the four video groupings. The high-agreement, positive-valence videos received the lowest difficulty ratings ($M = 2.70, SD = 1.83$) and the highest accuracy ratings ($M = 6.84, SD = 2.08$). These ratings varied significantly from ratings for the other video sets [difficulty: $F(3, 6991.71) = 477.58, P < .001$; accuracy: $F(3, 6791.04) = 116.11, P < .001$].

Linear mixed models were conducted on respondents’ ratings of difficulty and accuracy, according to the procedures described in Chapter 4. Analyses on ratings for all videos are first presented, followed by analyses for video groupings.

Does Experience with Dogs Predict Ratings of Difficulty?

All Videos
All participants. Experience was a significant predictor of difficulty ratings, $F(3, 15558.30) = 72.73, P < .001$, as displayed in Table C-1 and Figure C-2. Difficulty ratings decreased with experience, and all pairwise comparisons were significant. Experience remained a significant predictor of difficulty ratings even after adjusting for the sex and age of respondents, $F(3, 15515.55) = 33.09, P < .001$. Sex was not a significant predictor, but there was a negative association between age and difficulty ratings, $b = .06, t(15512.61) = 1.54, P = .12$, and $b = -.01, t(15483.18) = -13.57, P < .001$. Behavior professionals did not provide significantly different ratings from professionals working in nonbehavioral fields, $b = -.10, t(3255.37) = 1.75, P = .08$.

![Figure C-1. Mean difficulty and accuracy ratings by video grouping. Sig. pairwise comparisons (Sidak-corrected): Difficulty: High-agree pos-val < all; Accuracy: All < high-agree pos-val; Low-agree pos-val < high-agree neg-val.]

Table C-1. Parameter estimates modeling effect of experience on difficulty ratings.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>$B$ (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof10+</td>
<td>-.99 (.06)*</td>
<td>-1.12, -.85</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>-.76 (.07)*</td>
<td>-.89, -.63</td>
</tr>
<tr>
<td>Owners</td>
<td>-.64 (.06)*</td>
<td>-.75, -.53</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *$P < .001$
Behavior professionals excluded. Experience remained a significant predictor of difficulty ratings after behavior professionals were removed from the analysis, $F(2, 13001.42) = 69.49, P < .001$. All group comparisons remained significant.

Owners only. Respondents whose dog ownership history included five or more dogs and who interacted with three or more dogs daily reported less difficulty with interpreting the emotions of the dogs in the videos, $b = -.51$, $t(10464.79) = 14.20$, $P < .001$ and $b = -.33$, $t(10478.88) = 9.38$, $P < .001$. In addition, there was a negative association between difficulty ratings and the amount of time spent with one’s dogs, $b = -.03$, $t(9080.84) = -9.18$, $P < .001$.

Video Groupings

All participants. As displayed in Figure C-3, all of the experience groups rated the high-agreement, positive-valence videos as the easiest to interpret. Within each video
grouping, difficulty ratings varied by experience [High-agreement, positive-valence: $F(3, 5837.81) = 26.89, P < .001$; Low-agreement, positive-valence: $F(3, 3253.92) = 12.05, P < .001$; Low-agreement, negative-valence: $F(3, 3158.40) = 12.45, P < .001$; High-agreement, negative-valence: $F(3, 4262.62) = 37.87, P < .001$].

![Difficulty ratings for video groupings by experience](image)

**Figure C-3. Difficulty ratings for video groupings by experience.** Sig. pairwise comparisons (Sidak-corrected): High-agree, pos-val: All < Low-Exp; Low-agree, pos-val: Prof10+ < Prof<10, Own < Low-Exp; Low-agree, neg-val: All < Low-Exp; Prof10+ < Own; High-agree, neg-val: Prof10+ < Prof<10 < Own < Low-Exp.

The largest differences among the experience groups were found for ratings of the high-agreement, negative-valence videos. For example, the No-Experience group rated these videos as 1.3 points more difficult than the Prof10+ group. As experience increased, difficulty ratings decreased, and all of the experience groups differed significantly from each other. The groups’ difficulty ratings varied the least for high-agreement, positive-valence videos. The difference between the No-Experience and Prof10+ groups was .8 on a nine-point scale for this video set.
Behavior professionals excluded. Experience remained a significant predictor of difficulty ratings for all video groupings after behavior professionals were removed from the analysis [High-agreement, positive-valence: \( F(2, 4911.88) = 35.84, P < .001 \); Low-agreement, positive-valence: \( F(2, 2682.95) = 9.63, P < .001 \); Low-agreement, negative-valence: \( F(2, 2591.02) = 10.95, P < .001 \); High-agreement, negative-valence: \( F(2, 3517.87) = 15.74, P < .001 \)]. As in the full sample, difficulty ratings decreased with experience, and the experience groups differed the most in ratings for the high-agreement, negative-valence videos.

Owners only. Experience with dogs also predicted difficulty ratings within the Owners group. For all sets of videos (Figure C-4), respondents who had owned five or more dogs reported less difficulty with interpreting the dogs’ emotions than less-experienced owners [High-agreement, positive-valence: \( b = .44, t(3956.45) = -8.51, P < .001 \); Low-agreement, positive-valence: \( b = .66, t(2196.79) = -7.17, P < .001 \); Low-agreement, negative-valence: \( b = .46, t(2138.16) = -5.07, P < .001 \); High-agreement, negative-valence: \( b = .58, t(2903.35) = -7.59, P < .001 \)].

For all video groupings (Figure C-5), owners who interacted with three or more dogs daily reported less difficulty than owners who interacted with fewer dogs [High-agreement, positive-valence: \( b = .26, t(3965.01) = -5.20, P < .001 \); Low-agreement, positive-valence: \( b = .33, t(2199.49) = -3.64, P < .001 \); Low-agreement, negative-valence: \( b = .38, t(2133.93) = -4.18, P < .001 \); High-agreement, negative-valence: \( b = -.44, t(2905.37) = -5.88, P < .001 \)].

Lastly, for all sets of videos, difficulty ratings were negatively associated with the duration of time that owners spent with their dogs on a typical weekday [High-agreement,
Figure C-4. Difficulty ratings for video groupings by total number of dogs owned as an adult; owners only. All comparisons are significant at $P < .001$.

Figure C-5. Difficulty ratings for video groupings by number of dogs interacted with daily; owners only. All comparisons are significant at $P < .001$. 
posvalence: \( b = -.03, t(3429.69) = -5.85, P < .001 \); Low-agreement, posvalence: \( b = -.04, t(1944.15) = -4.60, P < .001 \); Low-agreement, negvalence: \( b = -.02, t(1861.29) = -2.73, P = .006 \); High-agreement, negvalence: \( b = -.04, t(2567.44) = -4.90, P < .001 \).

**Does Experience with Dogs Predict Ratings of Accuracy?**

**All Videos**

**All participants.** Experience was a significant predictor of respondents’ ratings of their own accuracy in interpreting the dogs’ emotions, as displayed in **Figure C-2** and **Table C-2**, \( F(3, 17085.02) = 49.28, P < .001 \). Accuracy ratings increased with experience, and all of the groups differed significantly from each other, except for the two professional groups. Experience remained a significant predictor of accuracy ratings even after adjusting for the sex and age of respondents, \( F(3, 17089.18) = 41.03, P < .001 \). Sex and age were also both significant predictors of accuracy ratings, \( b = -.18, t(17109.90) = -4.48, P < .001 \), and \( b = .004, t(17093.98) = 4.12, P < .001 \). Females rated themselves as less accurate than males, and accuracy ratings increased with age. Among professionals, behavior professionals provided higher accuracy ratings than those working in non-behavioral fields, \( b = .18, t(4314.32) = 2.73, P = .006 \).

**Table C-2.** Parameter estimates modeling effect of experience on accuracy ratings.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>( B ) (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof10+</td>
<td>.81 (.07)*</td>
<td>.67, .95</td>
</tr>
<tr>
<td>Prof&lt;10</td>
<td>.68 (.07)*</td>
<td>.54, .81</td>
</tr>
<tr>
<td>Owners</td>
<td>.48 (.06)*</td>
<td>.36, .59</td>
</tr>
</tbody>
</table>

*Reference group: Low-Experience. *\( P < .001 \)
Behavior professionals excluded. Experience remained a significant predictor of accuracy ratings after behavior professionals were removed from the analysis, \( F(2, 14044.45) = 38.01, P < .001 \). All group comparisons were significant.

Owners only. Within the Owners group, respondents who had owned five or more dogs or who interacted with three or more dogs daily rated themselves as more accurate than other owners, \( b = .30, t(11557.18) = 7.92, P < .001 \) and \( b = .17, t(11552.74) = 4.47, P < .001 \). In addition, there was a positive association between accuracy ratings and the daily duration of time that owners spent with their dogs, \( b = .02, t(10152.97) = 5.53, P < .001 \).

Video Groupings

All participants. As displayed in Figure C-6, all of the experience groups rated themselves as most accurate for the high-agreement, positive-valence videos. In addition, within each video grouping, accuracy ratings varied by experience [High-agreement, positive-valence: \( F(3, 6443.50) = 10.89, P < .001 \); Low-agreement, positive-valence: \( F(3, 3284.17) = 8.31, P < .001 \); Low-agreement, negative-valence: \( F(3, 3154.85) = 15.02, P < .001 \); High-agreement, negative-valence: \( F(3, 4258.29) = 21.71, P < .001 \)].

The largest differences among the experience groups were found for ratings of the low-agreement, negative-valence videos. For example, the No-Experience group provided accuracy ratings approximately one point lower than the Prof10+ group. Accuracy ratings increased with experience, and all groups differed significantly from each other, except for the two professional groups. The groups’ ratings varied the least for the high-agreement, positive-valence videos, for which the difference between the No-Experience and Prof10+ group was .7 point.
Behavior professionals excluded. Experience remained a significant predictor of accuracy ratings for all video groupings after behavior professionals were removed from the analysis [High-agreement, positive-valence: $F(2, 5310.00) = 10.78, P < .001$; Low-agreement, positive-valence: $F(2, 2701.53) = 10.44, P < .001$; Low-agreement, negative-valence: $F(2, 2587.08) = 9.37, P < .001$; High-agreement, negative-valence: $F(2, 3502.39) = 8.52, P < .001$]. As in the full sample, accuracy ratings increased with experience for all video groupings.

Owners only. Within the Owners group, the level of experience with dogs predicted accuracy ratings. For all sets of videos (Figure C-7) respondents who had owned five or more dogs provided higher accuracy ratings than less-experienced owners [High-agreement, positive-valence: $b = .23, t(4366.86) = 3.55, P < .001$; Low-agreement, positive-valence: $b = .38, t(2225.74) = 4.41, P < .001$; Low-agreement, negative-valence:
\[ b = .33, t(2136.59) = 3.72, P < .001; \text{High-agreement, negative-valence: } b = .32, t(2884.27) = 4.38, P < .001. \]

![Figure C-7. Accuracy ratings for video groupings by total number of dogs owned as an adult; owners only. All comparisons are significant at } P < .001.](image)

For all video groupings except the low-agreement, positive-valence set (Figure C-8), owners who interacted with three or more dogs daily reported higher accuracy than owners who interacted with fewer dogs [High-agreement, positive-valence: \( b = .14, t(4366.66) = 2.27, P = .02 \); Low-agreement, positive-valence: \( b = .04, t(2224.56) = .41, P = .68 \); Low-agreement, negative-valence: \( b = .27, t(2133.21) = 3.09, P = .002 \); High-agreement, negative-valence: \( b = .22, t(2883.30) = 3.08, P = .002 \)].

Lastly, for all sets of videos, accuracy ratings were positively associated with the duration of time that owners spent with their dogs on a typical weekday [High-agreement, positive-valence: \( b = .02, t(3830.45) = 2.39, P = .02 \); Low-agreement, positive-valence: \( b = .03, t(1978.77) = 3.03, P = .002 \); Low-agreement, negative-valence: \( b = .02, t(1862.99) \).]
Discussion

In this series of analyses, I explored respondents’ own ratings of accuracy and difficulty in interpreting the dogs’ emotions. Within each video grouping, accuracy ratings tended to increase with experience, while difficulty ratings decreased with experience, suggesting that experience leads to greater confidence in one’s own judgments.

As previously mentioned, humans recognize positive emotions in other humans with greater accuracy than negative emotions, and this skill develops with less social experience than the recognition of negative emotions. Results in previous chapters
suggested that this pattern might extend to interspecific emotion perception. Experience with dogs was not as influential in emotion ratings and categorizations for positive- than negative-valence videos.

Here, too, the differences among the experience groups for the high-agreement, positive-valence videos was smaller than for the other video groupings. In contrast, the largest differences among the experience groups for difficulty ratings occurred for the high-agreement, negative-valence videos, and the largest differences for accuracy ratings occurred for the low-agreement, negative-valence videos. If indeed positive emotion in dogs is easier to perceive and requires only minimal experience, then difficulty ratings for the high-agreement, positive-valence videos should have been the lowest for all the experience groups, while accuracy ratings should have been the highest. In fact, this result was supported by the data.

As discussed in the previous chapters, respondents of all experience levels appeared to distinguish clearly negative from clearly positive emotions. However, their ratings of difficulty and accuracy suggested greater ease with the latter. While respondents reported the highest accuracy and lowest difficulty for the high-agreement, positive-valence videos, they provided much lower accuracy and higher difficulty ratings for the high-agreement, negative-valence videos. In fact, both the Low-Experience and Owners groups reported the highest difficulty and lowest accuracy ratings for this set of videos.

Analyses using measures of experience other than the broad experience categories yielded similar patterns of results, showing that increased experience was associated with higher accuracy and lower difficulty ratings. Within the Owners group, the total number
of dogs owned as an adult, as well as the number of dogs interacted with daily, were both associated with difficulty and accuracy ratings. Furthermore, the number of hours that owners spent with their dogs was negatively associated with difficulty ratings and positively associated with accuracy ratings.

Taken as a whole, these results suggest that humans may possess some metacognitive awareness that clearly positive emotions in dogs (as judged by experts) are easy to interpret and that their interpretations of positively-valenced behavior are accurate. However, there appears to be much less ease and confidence regarding interpretations of negative emotions and weakly-valenced behaviors.
APPENDIX D

SUPPLEMENTARY ANALYSES FOR CHAPTER 4

Does Experience with Dogs Predict Ratings of Arousal in Dogs?

All Videos

Behavior professionals compared to other professionals. Among professionals, behavior professionals viewed the dogs as more excited than those working in non-behavioral fields when all videos were considered together, $b = .05$, $t(3722.32) = 2.43$, $P = .02$.

Behavior professionals excluded. Experience remained a significant predictor of Arousal scores after behavior professionals were removed from the analysis, $F(2, 12527.39) = 3.81$, $P = .02$. The Low-Experience group viewed the dogs as significantly less excited than owners (Table D-1).

Table D-1. Parameter estimates modeling effect of experience on Arousal scores with behavior professionals excluded.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>B (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professionals</td>
<td>.02 (.03)</td>
<td>-.03, .06</td>
</tr>
<tr>
<td>Owners</td>
<td>.05 (.02)*</td>
<td>.01, .08</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *$P < .05$

Owners only. Within the Owners group, the number of dogs owned as an adult and the number of hours spent with one’s dogs predicted Arousal ratings. Respondents who had owned five or more dogs tended to rate the dogs in the videos as being more excited, $b = .07$, $t(10241.20) = 6.14$, $P < .001$. In addition, Arousal scores increased with the time that owners spent with their dogs, $b = .002$, $t(8978.96) = 2.11$, $P = .04$. 
However, the number of dogs interacted with daily did not predict scores, $b = -.0007$, $t(10247.71) = -.06$, $P = .96$.

**Does Experience with Dogs Predict Ratings of Emotion in Dogs?**

**All Videos**

**Behavior professionals compared to other professionals.** Among professionals, behavior professionals viewed the dogs as experiencing more negative emotions than those working in non-behavioral fields when all videos were considered together, $b = -.07$, $t(3796.42) = 3.79$, $P < .001$.

**Behavior professionals excluded.** Experience remained a significant predictor of Emotional Valence scores after behavior professionals were removed from the analysis, $F(2, 13063.24) = 7.14$, $P = .001$. Parameter estimates are displayed in Table D-2. Pairwise comparisons demonstrated that owners provided significantly more positive ratings of emotion than professionals ($P = .001$).

<table>
<thead>
<tr>
<th>Experience group</th>
<th>B (SE)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professionals</td>
<td>-.03 (.02)</td>
<td>-.08, .01</td>
</tr>
<tr>
<td>Owners</td>
<td>.03 (.02)</td>
<td>.007, .07</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *$P < .001$

**Owners only.** Within the Owners group, the number of dogs owned as an adult predicted Emotional Valence scores, $b = .02$, $t(10637.36) = 1.97$, $P = .049$. Respondents who had owned five or more dogs tended to give more positive ratings. However, the number of dogs interacted with daily and the number of hours spent with one’s dogs did not predict scores, $b = .014$, $t(10633.01) = 1.15$, $P = .25$ and $b = -.0003$, $t(9288.05) = .25$, $P = .81$.
APPENDIX E
SUPPLEMENTARY ANALYSES FOR CHAPTER 5

Does Experience with Dogs Predict Emotion Categorizations?

All Videos

Behavior professionals compared to other professionals. Among dog professionals, the odds of selecting happy were 1.25 times higher for those working in non-behavioral compared to behavioral fields when all videos were considered together, \( \text{Wald } \chi^2(1, N = 554) = 4.22, P = .04 \). There was no difference between behavior professionals and non-behavior professionals in selecting the angry, sad, fearful, or neutral categories, \( \text{Wald } \chi^2(1, N = 554) = 2.05, P = .15 \), \( \text{Wald } \chi^2(1, N = 554) = .004, P = .95 \), \( \text{Wald } \chi^2(1, N = 554) = 2.62, P = .11 \), and \( \text{Wald } \chi^2(1, N = 554) = .001, P = .97 \).

However, six videos could not be included in the analysis of the angry category, and five videos could not be included in the analysis of the sad category due to instability in the statistical models.

Behavior professionals excluded. Experience was no longer a significant predictor of happy categorizations after behavior professionals were removed from the full sample, \( \text{Wald } \chi^2(2, N = 1779) = 3.18, P = .20 \). However, experience remained a significant predictor of angry, fearful, and sad categorizations, \( \text{Wald } \chi^2(2, N = 1779) = 43.69, P < .001 \), \( \text{Wald } \chi^2(2, N = 1779) = 73.47, P < .001 \), and \( \text{Wald } \chi^2(2, N = 1779) = 29.30, P < .001 \). The patterns of results were the same as for the full sample, with the Low-Experience group more likely to select angry and sad and less likely to select fearful than more-experienced respondents. Odds ratios are displayed in Table E-1.
Table E-1. Odds ratios for effect of experience on emotion categorizations with behavior professionals excluded.

<table>
<thead>
<tr>
<th>Experience group</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>.98</td>
<td>.77, 1.24</td>
</tr>
<tr>
<td>Owners</td>
<td>1.12</td>
<td>.93, 1.33</td>
</tr>
<tr>
<td>Fearful</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>2.85**</td>
<td>2.23, 3.64</td>
</tr>
<tr>
<td>Owners</td>
<td>2.17**</td>
<td>1.77, 2.65</td>
</tr>
<tr>
<td>Angry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>.28**</td>
<td>.18, .44</td>
</tr>
<tr>
<td>Owners</td>
<td>.37**</td>
<td>.27, .51</td>
</tr>
<tr>
<td>Sad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>.33**</td>
<td>.20, .55</td>
</tr>
<tr>
<td>Owners</td>
<td>.47**</td>
<td>.35, .64</td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>.85</td>
<td>.67, 1.06</td>
</tr>
<tr>
<td>Owners</td>
<td>.84*</td>
<td>.71, .99</td>
</tr>
</tbody>
</table>

Reference group: Low-Experience. *P < .05, **P < .001

aOverall X² for experience was not significant for neutral

Owners only. Within the Owners group, respondents who had owned five or more dogs as adults were more likely to categorize dogs as fearful and less likely to categorize them as angry than their less-experienced peers, OR = 1.15, CI = 1.02 – 1.31, P = .03 and OR = .67, CI = .53 – .84, P = .001. However, the number of dogs owned did not predict selection of the happy, sad, or neutral categories, OR = 1.02, P = .72; OR = .93, P = .59; and OR = .97, P = .58.

Owners who interacted with three or more dogs per day were less likely to categorize dogs as angry than owners who interacted with fewer dogs, OR = .72, CI = .57 – .90, P = .004. However, this variable was not associated with selection of the other emotion categories [fearful, happy, sad, and neutral: OR = 1.12, P = .08; OR = 1.05, P = .39; OR = .99, P = .96; OR = .94, P = .26].
As the daily number of hours spent with one’s dog increased, owners were less likely to categorize the dogs as angry and more likely to categorize them as fearful, $OR = .96$, CI = .93 - .98, $P = .001$ and $OR = 1.03$, CI = 1.01 – 1.04, $P < .001$. This variable was not significantly associated with selection of the other emotion categories [happy, sad, and neutral: $OR = 1.00$, $P = .73$; $OR = .97$, $P = .06$; and $OR = 1.00$, $P = .43$].
APPENDIX F

ANALYSES EXCLUDING PARTICIPANTS WITH PRIOR LEARNING ABOUT DOG BODY LANGUAGE

Overview

In order to investigate the role of experience in emotion ratings and categorizations apart from effects of learning, additional analyses were conducted without participants who had reported prior learning about dog body language. Linear mixed models were conducted on Emotional Valence scores, and logistic regression with generalized estimating equations were conducted on happy and fearful categorizations, as described in Chapters 4 and 5. 134 individuals from the Low-Experience group, and 459 individuals from the Owners group reported no prior learning about body language. 20 individuals from the Prof<10 group and 17 individuals from the Prof10+ group reported no prior learning. Given the small numbers in the professional groups, the two groups were combined for these analyses.

Does Experience with Dogs Predict Emotion Ratings?

Video Groupings

Participants with prior learning excluded. As displayed in Figure F-1, experience was a significant predictor of Emotional Valence scores for all video groupings except the low-agreement, positive-valence videos [High-agreement, positive-valence: $F(3, 1857.15) = 12.59, P < .001$; High-agreement, negative-valence: $F(3, 1204.13) = 3.03, P = .048$; Low-agreement, positive-valence: $F(3, 881.29) = 1.35, P = .26$; Low-agreement, negative-valence: $F(3, 836.43) = 3.78, P = .02$]. The largest
differences among the experience groups were found for perceptions of the low-agreement, negative-valence videos, while the smallest differences were found for the high-agreement, negative-valence videos.

![Graph showing emotional valence scores by experience group.](image)

**Figure F-1.** Mean Emotional Valence scores by experience for each video grouping; participants with prior learning about body language excluded. Sig. pairwise comparisons (Sidak-corrected): High-agree, pos-val: Low-Exp < Owners, Prof; Low-agree, neg-val: Prof < Low-Exp, Owners; High-agree, neg-val: Low-Exp < Owners.

**Does Experience with Dogs Predict Emotion Categorizations?**

**Video Groupings**

**Participants with prior learning excluded.**

*Happy category.* As displayed in Figure F-2, the likelihood of happy categorizations was significantly associated with experience for high-agreement, positive-valence videos only [high-agree, pos-val: $Wald \chi^2(3, N = 630) = 9.65, P = .008$; low-agree, pos-val: $Wald \chi^2(3, N = 630) = 3.69, P = .16$; low-agree, neg-val: $Wald \chi^2(3,$
The smallest differences among the experience groups were found for the high-agreement, negative-valence videos, for which the happy category was infrequently chosen by all experience groups. The largest differences among the experience groups were found for the low-agreement, negative-valence videos, though the differences were not significant due to the large standard error in the professional group.

**Fearful category.** As displayed in Figure F-3, experience was a significant predictor of fearful categorizations for high-agreement, negative-valence videos and a marginally significant predictor for low-agreement, positive-valence videos [low-agree, pos-val: \( \text{Wald} X^2(3, N = 630) = 4.93, P = .09 \); low-agree, neg-val: \( \text{Wald} X^2(3, N = 630) = 2.24, P = .33 \); high-agree, neg-val: \( \text{Wald} X^2(3, N = 630) = 22.50, P < .001 \)]. The analysis could not be run on data for the high-agreement, positive-valence videos due...
to instability in the model. The largest differences among the experience groups were found for the high-agreement, negative-valence videos.

![Graph showing probability of fearful categorizations for each video grouping by experience.](image)

**Figure F-3. Probability of fearful categorizations for each video grouping by experience; participants with prior learning about body language excluded.** Sig. pairwise comparisons (Sidak-corrected): High-agree, neg-val: Low-Exp < Own, Prof.

**Discussion**

For Emotional Valence scores, the largest differences by experience were found for low-agreement, negative-valence videos. Professionals provided more negative interpretations of emotion than the Low-Experience and Owners groups. For emotion categorizations, the Low-Experience group was less likely than the Owners group to categorize high-agreement, positive-valence videos as happy. Other comparisons for happy categorizations, while worthy of discussion, were not significant due to the larger standard error in the small professional group ($N = 37$). For example, professionals were less likely than less-experienced participants to select the happy category for low-agreement, negative-valence videos, while selection of “happy” tended to increase with
experience for the low-agreement, positive-valence videos. On the other hand, selection of the fearful category increased dramatically with experience for the high-agreement, negative-valence videos, mirroring results from the full sample. Selection of the fearful category also tended to increase with experience for the low-agreement videos, though the group comparisons were not significant. Non-significant trends discussed above could become significant with a larger sample of dog professionals who have not received prior learning on the topic of dog body language. Future studies should attempt to include such a sample.
APPENDIX G

STUDY ON DOGS’ RESPONSES TO HUMAN FACIAL EXPRESSIONS

Overview

Because of its unique relationship with humans, the domestic dog has served as an animal model for advanced social cognition for more than a decade (reviews: Miklósi, Topál, & Csányi, 2007; Topál, et al., 2009). Researchers have been particularly interested in the dog’s ability to respond to human communicative signals, such as human pointing gestures. Dogs follow these gestures more readily than nonhuman primates (Bräuer, Kaminski, Riedel, Call, & Tomasello, 2006) and develop these abilities at a younger age than similarly socialized wolves (Gácsi et al., 2009). More recently, dogs’ responses to human facial expressions have been a topic of interest. One study found that dogs discriminated between neutral and non-neutral faces, but that only adult dogs responded adaptively by looking away from angry faces (Deputte & Doll, 2010). The study below explored dogs’ responses to facial expressions presented by the experimenter and owner using more naturalistic methods than previous studies. In addition, a variety of demographic and experiential variables are explored to determine whether they play a role in dogs’ sensitivity to facial expressions.

Methods

All procedures were conducted with approval from the Columbia University IRB and IACUC (Protocol #AAAE7861 and #AAAB7022).
Subjects

Participants were recruited through a variety of means, including personal contacts, online postings, e-mails, press releases, and flyer distribution at dog events. Participants could schedule a participation session through the study website. 94 dogs participated with their owners. Owners were asked to complete an online survey asking for background information about themselves and their dogs before their appointments.

Procedure

Setup. The study location was a room in a home that measured 3.45 m by 3.80 m. A chair was located at one end of the room, and a gated entrance was located at the other end. The floor was marked with concentric semi-circles every 0.5 m to indicate the distance from the center of the chair for later behavioral coding. When owners arrived with their dogs, the experimenter explained the study and provided an informed consent form. While the experimenter was explaining the study, the dog was free to explore the study room. The dogs’ behavior throughout participation was recorded on video from two different angles.

Procedure 1: Experimenter and owner faces. The owners and the experimenter took turns presenting facial expressions (neutral with eyes closed, neutral, happy, angry) while sitting in the chair for 1 min. For half of the participants, the owners presented expressions first, and for the other half, the experimenter presented expressions first. The owner was shown a photograph from Ekman’s Pictures of Facial Affect as an example of the expression that should be made (Ekman & Friesen, 1976). The order of the expressions was randomized within experimenter and owner.
Once the presenter was seated, the other individual (experimenter or owner) opened the gate to let the dog into the room. The dog was free to walk around or approach the human. Only the human presenting the expression remained in the room during the trial, and the other human was, in most cases, not visible. For dogs who became very stressed when the owner was not visible, owners were instructed to stand just outside the entrance of the room where their dogs could see them, but keep their backs turned towards their dogs. The presenting human avoided speaking to, touching, and looking directly at the dog. Dogs who were very stressed or whose owners did not follow instructions were excluded from the analyses. Data from a total of 80 dogs were retained.

**Procedure 2: Social referencing.** In three separate trials, the experimenter moved a remote-controlled toy 0.5 m and responded to it with facial expression alone or matching facial and vocal expression. The facial expression was held throughout the trial. There were three toys, which were randomly assigned to each expression. The experimenter looked at the toy and presented the expression while the toy was moving. Once the toy stopped moving, the experimenter looked at the dog and then looked back at the toy. After looking back at the toy, the owner released the dog, and the dog was free to move about the room for 1 min. Dogs who were very stressed or whose owners did not follow instructions were excluded from the analyses. Data were retained for 25 dogs who received a facial expression alone and 42 dogs who received a facial expression combined with vocal expression. The owner remained in the room, but was instructed to face away from the dog after releasing him/her.

**Video Coding**
The videos were coded using the JWatcher program (Blumstein, Daniel, & Evans, 2006). Codes were entered to indicate the following behaviors: stepping within 1m of the emotion presenter or toy; sitting; lying down; looking at the experimenter, owner or, toy; making physical contact with the experimenter, owner, or toy; and vocalizing. The dependent variables were latency to approach within 1 m of the presenter or toy; total time within 1m of the presenter or toy; total time sitting or lying down; total time in physical contact with the experimenter, owner, or toy; number of looks at the experimenter, owner or toy; and number of vocalizations. Latencies and durations are reported in seconds below. Facial expressions were obscured in the videos before coding, and 20% of the videos were re-coded by a second coder to check for reliability. Intraclass correlation coefficients ranged from .73 to .99, indicating excellent interobserver agreement.

Results

Procedure 1: Experimenter and Owner Faces

A multivariate analysis of variance was conducted with emotional expression as a repeated measure to determine if the dogs’ behavior varied by expression. Additional models were run to explore the association between dogs’ sensitivity to expressions and a variety of predictor variables related to the dog’s demographics and experience with humans [dog’s sex, dog’s age, duration of relationship with owner, dog’s breed group, origin of dog, amount of training, duration of daily dog-owner interaction, and owner’s score on the Lexington Attachment to Pets Scale (Johnson, Garrity, & Stallones, 1992)].

The dogs’ behavior did not vary according to owner-presented expression, $F(18, 57) = 1.40, P = .17$. In addition, when the various background and experience variables
were included in analyses, there were no significant effects of expression or interactions between expression and these predictor variables. In contrast, the dogs’ behavior did vary according to experimenter-presented expressions, $F(18, 59) = 1.82, P = .04$.

Follow-up univariate analyses revealed that the total time within 1m of the experimenter and the total time in contact with the experimenter varied by expression, $F(3, 228) = 3.82, P = .01$ and $F(3, 228) = 2.80, P = .04$. Dogs spent more time within 1m of the experimenter when she displayed a happy expression ($M = 17.17, SD = 17.44$) than when she displayed a neutral expression with eyes closed ($M = 9.96, SD = 15.36$). Dogs spent more time in physical contact with the experimenter when she displayed a happy expression ($M = 6.57, SD = 12.27$) than an angry ($M = 3.55, SD = 8.63$) or neutral expression ($M = 3.43, SD = 8.42$).

When sex, breed group, and age were added as predictors of these behaviors, the effect of experimenter’s expression remained significant, $F(6, 62) = 2.65, P = .02$. Sex, breed, and age were not significant predictors, nor were there significant interactions between these variables and expression. In addition, the effect of expression was maintained when the various experience variables were included in analyses (duration of relationship with current owner, amount of training received, duration of daily interaction with owner, origin of dog, owner attachment). However, there were no significant interactions between the experience variables and expression.

**Procedure 2: Social Referencing**

Due to the larger number of variables related to this procedure and smaller numbers of participants, the analyses were slightly altered to conserve degrees of freedom. The variable measuring latency to approach within 1m of the toy was discarded
due to very high correlation with total time within 1m. The remaining variables were analyzed using two separate multivariate analyses of variance. The first analysis included variables relating to the dogs’ distance from and interaction with the experimenter or toy (total time within 1m of toy, total time in contact with experimenter or toy, number of looks at experimenter or toy), and the second analysis consisted of the remaining variables (total time sitting or lying down, total time in contact with owner, number of looks at owner, number of vocalizations). Emotional expression was included as a repeated measure, and additional models incorporating demographic and experience variables were conducted as described for Procedure 1.

When the experimenter responded with facial expression alone, the dogs’ behavior did not vary by expression. However, when owner-reported attachment to the dog was included in an analysis of the number of looks at the experimenter, the effect of expression was almost significant, and there was a significant interaction between expression and attachment, $F(2, 38) = 4.32, P = .05$ and $F(2, 38) = 4.75, P = .04$. The more attached owners were to their dogs, the less that dogs looked at the experimenter when she presented a fearful expression. In contrast, the number of looks increased with attachment in the neutral condition, and there appeared to be no relationship between looks and attachment in the happy condition. There were no main effects of expression or interactions for any of the other predictor variables.

When the experimenter responded to the remote-controlled toys with emotional expression in the face and voice, the dogs’ behavior did not vary by expression. However, when the duration of the dog-owner relationship was added to the model, there was a significant effect for expression and a significant interaction between expression
and duration on the number of vocalizations, $F(2, 60) = 15.59$, $P = .001$ and $F(2, 60) = 9.16$, $P = .01$. The longer the dog-owner relationship, the fewer vocalizations the dogs made in the fearful and neutral conditions. In contrast, there did not appear to be a relationship between these variables in the happy condition. There were no main effects of expression or interactions for any of the other predictor variables.

**Summary**

Dogs varied their behavior in response to expressions presented by the experimenter, but not their owners. They spent more time within 1m of the experimenter when she displayed a happy expression than a neutral expression with eyes closed, and they spent more time in physical contact with her when she displayed a happy than an angry or neutral expression. When the experimenter responded to a remote-controlled toy with various expressions, there was no main effect of expression on dogs’ behavior. However, dogs’ responses to expressions varied based on their relationship with their owners. As owners’ attachment to their dogs and the duration of dog-owner relationship increased, the number of looks at the experimenter and the number of vocalizations decreased in the fearful condition. In sum, these results suggest that dogs vary their behavior in response to facial expressions presented by a novel person and that the dog-owner relationship may influence responses to expressions.

**References**


