

THESIS

Mouths wide open: yawning as a communicative behavior in dogs

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ABSTRACT

Yawning is an action humans are very familiar with, yet this behavior is not unique to our species. Most vertebrate animals demonstrate yawning behavior. The cause of yawning is still uncertain, but yawns across vertebrate species seem to be concentrated around transitions between sleep and activity. Our most popular companion animal, Canis familiaris, also has periods of yawning before and after sleep. Dogs are naturally social living creatures and rely extensively on body language as a form of communication between group members. Behaviorists have suggested that some dog yawns are part of this visual communication system.

The object of this observational study was to confirm that dogs have two main yawn types: a "rest" yawn that occurs between sleep-activity transitions, and a "social" yawn occurring during social interactions. Social interactions in this study referred to both dog-dog and human-dog interactions. Communicative yawning is performed to displace anxiety in an individual dog or to pacify aggression or excitement in other individuals. The frequency of rest yawns was predicted to be higher than that of social yawns.

Both yawn types were morphologically the same, so the context of a yawn was used to indicate whether the yawn occurred for rest or communication. Even when recording the context of a yawn, distinguishing between displacement and pacification intentions was very difficult. Therefore, yawns motivated by displacement or pacification were collectively considered social in function.

Because social yawns only occur in the presence of other individuals, dogs were observed in the social settings of dog daycare and obedience classes. Individual dogs were observed for 15-20 minutes. Some observations were videotaped, but the majority were taken in real time. Behaviors immediately preceding and following a yawn were recorded using an ethogram tailored to rest, displacement, and pacification behaviors.

This study indicated that the majority of dog yawns occur during social interactions and not during sleep transitions. Using the yawn as a gauge to indicate if a dog is anxious or relaxed is one step towards more effective communication between dogs and humans. A yawn can act as a behavioral cue for dog handlers, trainers, owners and anyone concerned with canine welfare.

CHAPTER 1

Introduction

With mouth stretched wide, lips pulled back, and every sharp, shining tooth on display, the yawning dog may look a bit intimidating. While it may seem like he is intentionally showing off his considerable dental weaponry, the dog's yawn is controlled by reflex, a trait shared with human yawns. Despite physiological similarities, dog yawns are not necessarily synonymous with those of humans. Dogs yawn less frequently than humans do. A dog at the veterinarian's office will yawn an average of four times in an hour, compared to the 23 yawns per hour of a college student during a lecture (Phillips & Hoffman, 2000). Unlike humans, dogs also yawn outside of sleep/activity transitions. The possibility exists that all dog yawns are rest yawns, as in human beings. This study investigates the alternative, that dogs yawn in both restful and social contexts, and that some dog yawns serve a communicative function. I predict that dogs yawn more often during rest than during social situations. Few behavioral studies have dealt with the activity of yawning; most ethological yawning studies are based on primate subjects. In one such study, 90% of all yawns occurred during transitions between rest and activity and 10% during social contexts (Deputte, 1994). I expected to find a similar proportion among dog yawns.

Yawning is a basic behavior every human is familiar with. Yet the yawn is not unique to *Homo sapiens* or to *Canis familiaris*, the domestic dog. Yawning has been observed in a variety of vertebrate species. Baenninger (1987) recorded yawns in Siamese fighting fish, and yawns have also been observed in ostriches (Sauer & Sauer, 1967) and mammals. Mammalian yawns occur more frequently among carnivores than among herbivores (Baenninger, 1997). Yawns have been observed in rats (Anias et al, 1984), lions (Baenninger, 1987), canids (Beerda et al, 1997 & 1999; Bekof 1974; Lund et al, 1999) and in several of the non-human primates, including chimpanzees, mandrills, mangabeys and macaques (Aureli & de Waal, 1997; Baenninger, 1987; Deputte, 1994).

Even though yawning behavior occurs across all the vertebrate classes, the cause and physiological benefit of yawning remains a mystery. The motivation behind a yawn may not be the same for all animals. Suggested reasons for yawning include elevation of blood oxygen levels (Greco et al, 1993), evacuation of the tonsillar fossae (McKenzie, 1994), a mechanism for arousal (Askenasy, 1989; Baenninger, 1997; Greco et al, 1993), and social communication that influences the behavior of other individuals (Rugaas, 1997; Smith, 1999). High daily yawning frequency has been selectively bred for in a line of laboratory rats, demonstrating that yawning is at least partially influenced by genetics (Anias et al, 1984).

Yawning patterns appear to follow a circadian rhythm (Anias et al, 1984; McKenzie, 1994) with peaks during sleep/wake transitions (Deputte, 1994; Greco et al, 1993). However, Baenninger (1987) observed no yawns immediately before or after sleep in zoo kept mandrills. Rather, he found both mandrills and lions yawned with the highest frequency during periods of arousal, such as the hour before feeding time. For wild animals kept in a low stimulation environment, feeding time is probably the most stimulating part of their day. This finding supports the idea that yawns function to arouse the nervous system in anticipation of events. Baenrnnger also found that male Siamese fighting fish rarely yawned when kept

isolated. He then paired the fish with other male Siamese fighting fish - the fish could see each other through a Plexiglas barrier - and observed that yawning frequency increased significantly in both members of the pair.

Humans and other animals have also demonstrated increased yawning during transitions in arousal levels. Human subjects yawn with the highest frequency the first hour after waking and the hour proceeding sleep. We also have peaks of yawning during activities where periods of physical relaxation and mental alertness alternate, such as when sitting in lecture or driving in the car (Greco et al, 1993). In primates, yawning was induced in mangabeys and macaques during social interactions that involved, ". . . an increase in arousal or a conflict of drives." (Deputte, 1994). Canids also show this relationship between yawns and stimulating events. Dogs that were chronically stressed and then presented with a mild disturbance, such as the slamming of a door, yawned with a higher frequency than dogs kept in low stress environments (Beerda et al, 2000). The authors of this study concluded that yawns were an indicator of higher than normal arousal levels in the chronically stressed animals. Dogs also yawn as activity decreases. Videotaped observations of dogs with separation anxiety revealed an increase in yawning just prior to rest (Lund & Jorgensen, 1999). According to the arousal hypothesis, this pre-sleep yawning is an effort to stimulate the brain and ward off sleep (Baenninger, 1997).

Some attention has been given to the idea that yawns can serve as behavioral indicators of well-being in animals. Yawning has been used to index social stress in chimpanzees kept in high density living conditions (Aureli & de Waal, 1997). When the chimps were housed in indoor runs where space was limited, behavioral indicators of stress - both yawning and body scratching - occurred more often than when the chimps had more social space. In a study related to the research on chronic canine stress, yawns were an indicator of acute stress in dogs (Beerda et al, 1998). Yawns that occur outside arousal transitions, as observed in these studies, may have a communicative function (Redican, 1975). The communicative value of yawning has been proposed by several authors. Although their studies confirm that yawns occur in social contexts and that motivation for yawning exists outside of activity transitions, true communicative yawning has yet to be confirmed.

Animals that live in social groups rely on communicative behaviors to reduce conflict among group members (Dunbar, 1979). In many ways, the social system of dogs is similar to that of people. Like humans, dogs live in groups that are essentially an extended family, their young require extensive parental care, and they work as a group to provide for and raise the young. Also, dogs use play as one method of developing social skills, and they communicate extensively through a variety of vocal and non-vocal signals. Humans use complex verbal signals to communicate with one another, but other animals are incapable of speech and so naturally must use other mediums of communication. Social living animals, like the dog, especially have a highly developed system of non-verbal communication. The most complicated aspect of canine communication is that of body language. Dogs use subtle cues in their communication, cues humans may not be aware of, but can learn to detect.

Dogs subtly change their body posture and position of mouth, ears, eyes and tail to communicate with each other. Their body language conveys information to other dogs about dominance, confidence, inferiority, fear, friendliness, or intention to play. Because they must be able to receive these signals as well as send them, dogs are acutely aware of subtle changes in behavior and posture, both in their canine and human counterparts (Fox, 1971). Just as humans talk to dogs using human language, dogs try to communicate with us using dog language. This communication barrier can be an obstacle preventing a happy, healthy relationship between man and dog. "In particular, the combinations of different types of signals (visual, acoustic, tactile and olfactory) must be investigated to see how they combine to establish, reinforce and end interactions [between man and his pet]." (Mulot & Filiatre, 1986).

Because many of the behaviors dogs offer us are presented for purposes of communication, it is reasonable to wonder if yawns are included in these communicative behaviors. Smith (1999) suggests two functions for yawning: individual physiological benefit, and communication, where the behavior of another individual is influenced by a yawn. In his study on primates, Deputte (1994) distinguished between two yawn types. He found the 'rest yawn' to occur during transitions between sleep and activity and the 'emotion yawn' that followed social interactions and expressed anxiety, conflict, or threat. Both yawn types were morphologically similar and could only be classified based on context.

Yawns occurring in a social context have been further divided into displacement and pacification behaviors. Displacement activities occur during conflict between two motivational states, for instance, the fight or flight response. When unsure of which response to give, the animal will perform a behavior completely unrelated to the situation. "The individual tries to achieve a sense of security by performing an activity which it feels safe with and connects with pleasure." (Abrantes, 1997). In primates, yawning and body shaking are two common displacement activities that increase in frequency during stressful situations (Macstripieri et al, 1992). Dogs also have specific displacement behaviors. Besides yawning, canine displacement activities include sexual behaviors, territory marking, and muzzle nudging. The yawns observed in the dog studies by Beerda et al (1997, 2000) may indeed have been a displacement behavior, although the authors suggest only that the yawns indicate acute and/or chronic stress.

Pacification behavior, or behavior presented to show friendliness or suppress aggression in another individual, is the other sub-type of social yawn (Abrantes, 1997). As social structure evolved in the wolf ancestors of dogs, individuals had to adapt to living, hunting, and feeding in close proximity to other highly aggressive individuals (Dunbar, 1979). Fight avoidance was evolutionarily advantageous because fighting wastes energy and can result in serious injury. Certain behaviors arose to bypass aggression and show friendly intentions. A dog will perform pacification activities to suppress the aggression it perceives in another individual, either dog or human. Rugaas calls pacification behaviors "calming signals" and explains the importance such signals have in maintaining harmony and avoiding conflict in wolf and dog social groups. Pacification yawns, therefore, are performed to change the behavior of another individual. The difference between displacement and pacification yawns

is very subtle, and depends on the context the yawn occurs in.

Most dogs easily learn at least a few words of the human language. Basic obedience training relies on the dog's ability to learn to recognize and distinguish between commands such as Sir, DOWN, COME, and STAY. One of the first words a dog learns to respond to is its own name. The responsible dog owner should in turn learn to decipher the signals the dog presents to him or her. When a dog becomes anxious and nervous at the veterinarian's office, perhaps the owner could give an exaggerated yawn, promoting calm and relaxation in the dog's own language. Dog trainers could watch for yawns to know when they have pushed a dog too far and should maybe try a new training approach. Taking advantage of the acute canine awareness of body cues, and using more non-verbal signals, might lead to more effective training. Rugaas relates that, "In many cases dogs become hysterical when I answer them in their own language." Yawns could also be used to index stress levels in shelter dogs. Therapy or assistant dogs that suddenly engage in a spate of yawning are not indicating boredom, but rather that they are uncomfortable in a given situation. Many applications exist for this one, simple behavior.

CHAPTER 2

Methods

To test the hypothesis that dogs perform more rest yawns than social yawns, an observational study was designed. Preliminary observations indicated that all dog yawns are morphologically similar; therefore, the context of a yawn was used to categorize it either as rest or social. Both pacification and displacement yawns were categorized as social yawns.

Many of the yawns that occur in the animal world may not be true yawns, but rather gaping of the mouth (Baenninger, 1987). True yawns have two components: mouth movement and respiration. A true yawn involves wide opening of the mouth accompanied by deep, slow inspiration and a more rapid expiration (Baenninger, 1997; Deputte, 1994; Provine et al, 1987a; Smith, 1999). At times the dogs I observed gave quick mouth gapes. I did not count these as yawns because they lacked the respiratory component of true yawns. Only yawns consisting of both basic parts were considered yawns in this study. Other components of the yawning reflex in dogs were a lowered head, ears pulled backwards, exposure of the teeth, and eyes partially or fully closed. All dogs exhibited these traits while yawning.

I decided rather than observe individual, isolated animals, I would watch dogs that were interacting with other dogs or people. Beerda et al (1997) found that stressful stimuli elicited yawns from dogs only when an experimenter was present. During stimuli given while the dog was alone, no yawns occurred. The presence of another individual seems integral in stimulating yawning. A study on infant canid behavior indicated that the presence of another animal serves as a stimulus for both yawns and play-soliciting (Bekoff, 1974). With this in mind, I chose two social situations from which to make my observations. All observations were made at the Canine Learning Center in Fort Collins, Colorado between November 2000 and May 2001.

One type of situation studied was canine daycare. During the day owners left their dogs at the CLC facility under the supervision of the CLC staff. The dogs were allowed to play and interact with each other. I recorded data during Monday, Wednesday, and Friday daycare sessions. Most owners did not bring their dogs to daycare everyday, so I had only partial overlap of dogs on the three different days. Dogs ranged in age from four months to ten years old. A wide variety of dog breeds were represented, including Labrador and Golden retrievers, Huskies, several breeds of terrier, German shepherds, a Doberman Pinscher, Great Dane, and several mixed breeds.

Observations were made between 8:00 and 11:30 in the morning during intervals of two hours. I found that two hours was the length of time I could keep my attention on the dogs without becoming distracted. During these morning daycare sessions, the dogs were kept off-leash in a large room and were free to move about as they chose. Some dogs played with others, some preferred to chew on toys or stay off by themselves, still other dogs napped. A wide variety of behaviors and interactions occurred during the observation intervals. At noon all dogs were kennelled and allowed a time of rest.

A second situation that provided dogs with social interaction was obedience class. All classes observed were held at the Canine Learning Center. The different classes I observed were Puppy Prep, for dogs between the ages of four and eight months, and beginning and intermediate obedience for dogs older than four months. Classes are open to all breed types, although class size is limited to 12 dogs. All obedience classes were held in the evening between 5:00 and 9:00 PM. Also important to note is that I made observations only during the first night of each class. After the initial experience, dogs became accustomed to the CLC facility, the instructor, and the other dogs in class. I wanted to observe the dogs' reactions on the first night of class while the situation was new to them.

Dogs were exposed to two different social settings during obedience class. When owners first arrived with their animals they waited for a brief time in a small waiting room measuring 400 square feet Figure 1a shows the waiting room and its seating arrangement. By the time class began, the room was full of 10-12 dogs accompanied by their owners. Little space remained between dog-owner pairs.

Once class started, the owners and their dogs moved into a 1800 square foot exercise room, and all pairs were free to spread a comfortable distance apart. Figure 1b is a photograph of the exercise room. Each class lasted for 60 minutes. During class, dogs were no longer under the stress of a high-density situation. Instead, dogs were asked to perform new behaviors in a strange room with different dogs, people, and new smells. The dogs were exposed to novel sensory input, while at the same time being expected to perform at a high level of concentration and control.

After choosing the observation settings, I then developed a method for recording observed yawns as useful data. My goal was to observe as many dogs as possible, and by the end of data gathering I had watched a total of 84 dogs. Each dog was followed individually for 15-20 minutes. Before I started observation of a dog, I recorded the date, type of session (daycare or obedience class), and the name of the dog, as well as its age, sex and breed. This information was recorded on a check sheet, a new sheet for each animal (see appendix A). If the age or breed of a dog was unknown before observation, I checked the dog's records before leaving the CLC.

At the end of each observation segment, the average activity level of the dog was recorded. Activity level was based on a scale of 1 to 5, with 1 representing extremely low physical activity. Values were assigned based on the following definitions for each level.

1. Dog is sleeping or, if awake, lying down. Did not stand up during the observation period.
2. Dog spends majority of the observation time in a lying or sitting position. Brief periods of standing or walking.
3. Equal time spent between standing, walking, running or playing and sitting or lying down. Also includes dogs with high 'excitement levels but that are being restrained

from moving by collar, leash, or the owner's body.

4. Majority of time spent walking, running, or in play. Brief periods of sitting or lying.
- 5- Entirety of observation time spent running or playing with others. Did not sit or lie down during this time.

Because I could not discriminate between rest yawns and social yawns based on physical appearance, I needed to somehow record the context of the yawn. While watching each dog, I kept track of yawn behavior using the aforementioned check sheet. This sheet was basically a checklist of behaviors based on an ethogram developed for this study. The ethogram consisted of behavioral states - such as lying down or walking and behavioral events. Events occur in a shorter time span than states and reveal more about the dog's motivations. For this study, the ethogram focused on activities presented for pacification or displacement, and some behaviors related to anxiety and play. The different behavioral states and events were defined as follows:

BEHAVIORAL STATES

- Sleeping** - Lying down, head resting on ground or paws, eyes closed.
- Lying Down** - Middle section of body in contact with the ground or floor.
- Sitting** - Hind end in contact with the ground or floor.
- Standing** - Body in upright, stationary position.
- Walking** - Movement without an in-air phase. In other words, at least one paw is touching the ground as the dog moves.
- Trotting** - Movement with an in-air phase where the hindlegs do not extend forward past the midline of the body.
- Running** - Movement with an in-air phase where hindlegs extend forward past the midline of the body.

BEHAVIORAL EVENTS

- Head Turn** - Head turned away, thereby breaking eye contact with the individual approaching or interacting with the dog. The movement can be a slight adjustment, or the head can be moved fully to the side. In some cases, turning the head may result in the dog looking forward. For instance, a dog sitting by his owner's side must turn his head towards her to look at her. When turning the head away to break eye contact, the dog might look straight forward or in the direction opposite the owner.

- **Hip Nudge** - The dog approaches another individual, turns around, and gently bumps them with the hip or backside.
- **Licking** - Dog licks another dog usually around the mouth and muzzle, or licks a human, often on the hands or face. Licking movements can also occur when no other individual is near.
- **Muzzle Lick** - A quick movement of the tongue in which the dog licks his own nose or muzzle. Dogs also will lick around their mouth after swallowing, so care must be taken to distinguish if the lick was reflexive or communicative.
- **Muzzle Nudge** - One dog gently nudges its muzzle against the muzzle of a second dog. This behavior can also be directed towards humans, with the dog using its muzzle to nudge a person's hands or legs. Dogs may also nudge at the air when no other individual is in close proximity.
- **Pawing** - Paw lifted to touch someone or something. A dog might paw the air if the individual the movement is intended for is a short distance away.
- **Play Bow** - A play solicitation movement where the front part of the body is positioned as if lying down, while the back end sticks up in the air.
- **Submissive Crouch** - Body held low to the ground, tail is lowered or tucked between the legs, and the ears lowered or flattened.
- **Stretching** - Front legs extended while the muscles are flexed, followed by extension and stretching of the hind legs.
- **Turn Away** - Dog turns its side or back to another individual. Similar to the head turn except that the entire body is moved.

Space was left on the check sheet for additional behaviors to be added, for instance barking, whining, panting (rapid inhalation and exhalation with the mouth open), and leash-pulling (the dog strains against his collar while being restrained). Each behavior listed was followed by a column for 'before' and 'after,' for recording the behavior that occurred before and after the yawn. Room was left at the bottom of the page for any comments about the observed yawns. I often made notes in this space about the context of the yawn or information about the dog, for instance if it was his or her first day at daycare.

The majority of daycare observations, and all obedience class observations, were made in person. Five daycare sessions were video taped and reviewed at a later time. Taped observations were recorded the same way as real time observations were made. Each dog was followed for approximately 15 minutes with the camera.

During daycare a small area at the front of the exercise room was fenced off with three foot high metal fencing to prevent the dogs from interacting directly with the staff members. Figure 2 is a photo of the front of the room and the fenced space. I made my daycare observations from this fenced area. For obedience classes, I sat on a bench in the corner of the exercise room. Inevitably, a person or dog would sometimes block my line of vision. When this happened I simply waited for the obstacle to move. If a minute passed and my view was still blocked, I changed my own position, either by standing up or moving over to one side.

When a dog I was watching yawned, I recorded the behavior that occurred during the 10 seconds before and the 10 seconds after the yawn. A more active state took precedent over a less active one. For example, if a dog was walking around, then sat down and yawned, I recorded the before activity as 'walking.' Also, an event was recorded over a state. Following a yawn, a dog in a sitting position who then gave an identifiable head turn was recorded as 'head turn' in the after column. If two events occurred before or two occurred after the yawn, the event that happened in closest proximity to the yawn was recorded.

I used numbers in the before and after columns to indicate which yawn corresponded to which set of behaviors. For instance, a dog who was lying down, yawned for the first time, and then got up and walked around would receive a number one in the before column of 'lying down' and a number one in the after column of 'walking.' The second yawn would be designated by the number two, and so on.

After months of observations, and review of the video tapes, I went through the checklists and classified each yawn as being social or rest. This task was a complicated matter, so I developed criteria for classification and maintained consistency as I went through the data. I had to first decide what combination of behaviors indicated a rest yawn. During my background research, I had determined that rest yawns occur during transitions in arousal level, either going from activity to rest or vice versa. Therefore, transitions in states were considered rest yawns. For example, a series of lying down - yawn - sitting - walking was classified as a rest yawn. Likewise, a dog that spent time playing, sat, yawned, and laid down was also considered to have given a rest yawn.

A yawn that occurred during a low activity state, such as lying down or sitting, and did not occur in conjunction with an event, was recorded as a rest yawn. This criteria included dogs that were lying down or sitting both before and after a yawn and engaged in no other activities or behaviors.

A few exceptions were made to the rest yawn criteria. If a dog was sitting, yawned, and continued sitting, yet it was clear his attention was on another individual, I considered this a social yawn. A good example of this situation was a male Golden retriever named Max. Max was lying down when two dogs who were playing ran into him. Max yawned, facing them, but did not change position or give any other behavior that I could perceive. In cases such as this, I made notes about the context of the yawn if I felt confident it was directed toward another individual and not merely arousal reflex.

Social yawns were defined as being proceeded or followed by an event. Some yawns had event behaviors both before and after. The events I used for this study were communicative behaviors, so I considered yawns to have a social function when they occurred in conjunction with these behaviors. Instances of social yawns included a German shepherd who turned his head away from a growling dog, yawned, then gave a muzzle lick, and a Labrador Retriever who was standing off by herself but yawned and turned her head away from a dog who approached her and solicited play. In these examples the muzzle lick and head turns were the behavioral events.

Stretching was the one event that, when occurring along with a behavioral state, did not result in a yawn being considered social in nature. The stretching reflex appears to accompany yawning in dogs (Baenninger, 1997) and is a primitive component of the waking phase (Provine et al, 1987). Stretching while transitioning from rest to activity parallels the arousal mechanism of rest yawns.

Dogs that did not yawn were included, along with the dogs that did yawn, in the data analysis. Analysis was done using Minitab statistical software. Because my data was normally distributed, as confirmed by the Ryan-Joiner test for normality, I used parametric tests to analyze the data. For all tests, a value of alpha = 0.5 was used to determine significance.

A one-way analysis of variance was employed to test for equality between the mean number of all yawns in general, social yawns, and rest yawns in each activity level. A Pearson r-correlation and regression analysis was used to determine if activity was a reliable predictor of the two different yawn types, as well as yawns in general.

The ANOVA test was also used to detect any differences between age group and mean number of yawns. In looking at the effects of age and session type on yawning, a two sample t-test was utilized, since only two means were being compared.

Finally, to test the hypothesis that rest yawns occur more often than social yawns, a paired t-test was performed over all the data. The paired t-test was also used on data from daycare and obedience classes separately.

CHAPTER 3

Results

Of the 84 observations made, both in-person and videotaped, 35 were made during daycare, 49 during obedience classes. Out of 84 dogs, 44 were female and 40 male. The dogs ranged in age from puppies of 3 months to a bitch of 9 years. Thirty dogs were under one year of age, 37 were one year old or older, and age was unknown for 17 of the dogs (see Appendix B for all subject data). Before data analysis, ages were clumped together in three groups. Group 1 contained dogs less than one year old ($= 30$). Dogs from one year of age up to three years of age fell in Group 2 ($g = 18$). Finally, Group 3 were dogs three years or older ($g = 19$).

The number of breeds represented in this study was 33, accounting for 63 of the dogs. The remaining 21 dogs were either a known mix of breeds or an unknown mix and classified simply as "mixed breed." The most common dogs seen were Labrador retrievers, German shepherds, and Golden retrievers, in that order. This representation is not surprising given the current popularity of these three breeds in North America.

An activity score of 3 was the most common level of activity seen, as displayed in Table 1. Only one dog actually scored a 1; she slept during the full fifteen minutes she was observed. No dogs were classified at an activity level of 5, meaning that no dogs ran and played for the entire observation interval. All dogs spent at least a short time sitting or lying.

A total of 149 yawns were recorded during this study. Of the 84 dogs, 63% (53 dogs) yawned during their observation interval. The one dog who slept during her entire observation time did not yawn at all. Dogs that were at an activity level of 2 had the highest percentage of yawns at 72%, followed by the more active Level 3 dogs of which 68% yawned. Only 29% of the dogs active enough to score a 4 actually yawned.

The mean number of yawns given, when averaged over the total number of dogs observed, was 1.3 yawns per dog. As an observer, what interested me were the above average yawners. Just as some dogs never yawned, others yawned quite frequently. I saw several dogs that gave multiple yawns during very short time periods. One of these dogs was a female Labrador retriever named Cocoa. She had been lying on the floor napping. As she woke up- first lifting her head up, then mouth wrestling with a dog lying near her- she gave a series of five or six yawns, all within a ten minute time span. These were classified as rest yawns since she was transitioning from sleep to activity.

Another example was a female mixed breed puppy of four months. While waiting with her owner for her first puppy prep class to begin, she yawned a total of five times in less than fifteen minutes. During this time she pulled on her leash, barked and showed much agitation and excitement.

The waiting area seemed to be a stressful scene for dogs of all ages. Another dog, a five year old male greyhound, yawned five times in the first seven minutes of observations. As he

waited with his owner, other dogs were arriving for class and his owner continually bent over him, put her arms around him, and kissed and stroked his head.

The most frequent yawner was a female English setter mix. She yawned a total of eight times during her observation interval. Most of her yawns were given while standing or walking around. She paced around the room, weaving in and out of clusters of playing dogs, and yawned as she passed them. In another instance, a dog who was playing ran into her where she stood and she looked away from him and yawned.

While I saw individual dogs give multiple yawns, these yawns failed to induce yawns in others around them. Even when a dog yawned several times in close proximity to another dog, the other dog did not start yawning. Cocoa, the Labrador retriever mentioned before, was giving her series of yawns right in the face of a Golden retriever lying next to her. The retriever, however, did not yawn even once. I saw no evidence of yawn contagion between the dogs I watched. Human yawns, meaning the yawns emitted by myself or employees of the CLC, also did not result in yawns among the dogs.

Some of the situations in which yawns were observed stood out to me, either by being unexpected or very consistent in causing yawns. An example of an unexpected yawn was a female Belgian turverin, 18 months old. She was a very active dog and spent most of her fifteen minutes playing and interacting with other dogs. At one point she moved away from the others and laid down against the wall for just over a minute, still alert and watching the other dogs playing. She then yawned and a few seconds later got to her feet and began chasing her old playmate. Because I could not determine that she had directed her yawn at another individual, I considered the yawn to be a rest yawn. She transitioned from high activity to resting in a lying position, back to high activity, and gave no sign of displacement or pacification.

Still other situations were not so unexpected, but rather very consistently tied to yawns. The daycare dogs often gathered around the fenced off area at the front of the exercise room. During this time the dogs are pressed close to each other, all trying to push to the front. The dogs are facing the same general direction and looking up at the gate and more often than not at least one of the dogs would yawn. Figure 3 is a photo of the dogs gathered around the fence. The Labrador retriever to the right of center is yawning.

The situation that most consistently produced yawns involved owner-dog interaction. During obedience classes, both in the waiting room and in class, many of the dogs were excited and aroused by their new surroundings. In an effort to calm and restrain their pet, the owner often would physically force the dog into a SIT or DOWN position and hold them there by pulling on the dog's collar or by pressing on the dog's body. Still other owners wrapped their arms around the squirming dog, held them in their lap, or continually said the dog's name and told it to SIT or calm down. Dogs who were physically restrained in this manner yawned a great deal. Most of the yawns I observed during obedience class were emitted by dogs being tightly restrained by their owners. A one-way analysis of variance was performed on the number of rest yawns for each activity level and indicated no significant

difference. Also insignificant were the number of social yawns given 1» each activity level.

To determine if a correlation existed between the activity level of a dog and the number of yawns exhibited or if the two are independent of each other, a regression analysis was performed. Because activity level was a qualitative trait, dummy variables were created so that both activity level and number of yawns were quantitative data. Figure 4 is a fitted line graph using a cubic regression model. This graph helps to illustrate the pattern of yawning seen in this study. However, activity level was not a reliable predictor of number of yawns.

No significant correlation existed between activity level and the number of social yawns. The occurrence of social yawns appears to be independent of the animal's level of activity. Rest yawns also were not significantly affected by activity level.

Observation session and number of yawns To test whether dogs yawned more during observations made in daycare or obedience, a two sample t-test was performed.

The mean number of yawns during daycare ($M = 2.11$, $SD = 2.08$) and all three types of obedience class ($M = 1.53$, $SD = 1.71$) did not vary significantly, $t(64) = 1.36$, $p = 0.18$. The two situations elicited a similar number of yawns from dogs.

In looking at specific yawn types, a two sample t-test revealed no significant difference between the mean number of social yawns given during each session. The same test was also performed for the mean number of rest yawns. Averages for rest yawns made during daycare ($M = 0.77$, $SD = 1.21$) in comparison to those made during obedience classes ($M = 0.22$, $SD = 0.51$) did differ significantly from each other, $t(42) = 2.51$, $p = 0.016$. Rest yawns were more likely to occur during daycare than during any of the obedience classes.

Sex of the dog and number of yawns The number of male and female dogs in this study was almost equal and I was curious to see if either gender yawned significantly more than the other. A two sample t-test was performed on the mean number of yawns for males ($M = 1.48$, $SD = 1.50$) and females ($M = 2.05$, $SD = 2.16$). No significant difference was found between the sexes, $t(76) = 1.42$, $p = 0.16$. Thus, females yawned just as often as males and vice versa. In this study, all males over eight months of age were neutered and the majority of females were spayed.

Age of dog and number of yawns A broad range of ages were represented in this study. Although 30 dogs were under one year of age, the number of dogs in each one year interval after age one were more normally distributed. Because of the overrepresentation of puppies, dogs were clustered into three groups based on their age. Group 1: dogs less than one year old, Group 2: dogs one year old up to, but not including, three years of age, and Group 3: dogs three years old or older.

The effect of age on yawning frequency was analyzed using a one-way ANOVA, as illustrated by Figure 5. As shown by the boxplot, the mean of all three groups did not vary a

great deal. The ANOVA test revealed no statistically significant difference between the mesh number of yawns for each age group, $F(2, 64) = 0.59$, $p = 0.559$. The ages of 17 of the dogs were unknown. These dogs were not included in this part of the analysis.

Frequency of each yawn type A total of 111 social yawns ($M = 1.32$, $SD = 1.69$) and 38 rest yawns ($M = 0.45$, $SD = 0.91$) were recorded over the course of this study.

Intuitively this difference appears to be substantial. Analysis using a paired t-test on the data for the number of social vs. rest yawns verifies a statistically significant difference between the two means, $t(84) = 4.08$, $p < 0.001$. Figure 6 is a histogram showing the differences in number of social and rest yawns. Positive numbers on the x-axis indicate more instances of more social than rest yawns, negative numbers more rest than social. Frequency on the y-axis refers to the number of dogs within each difference. The circle labeled H_0 represents the null hypothesis for the t-test, that the difference between the mean number of social and rest yawns should be zero. The difference measured in this study was actually 0.87, as indicated by the circle labeled $x\bar{}$.

To determine if social yawns also occurred with a higher frequency than rest yawns during either daycare or obedience class, I analyzed the two types of yawns in each session. For the data gathered during daycare, the difference between the means for social and rest yawns was small and a paired t-test showed the difference to be insignificant. However, during obedience class, the mean number of rest yawns ($M = 0.224$) when subtracted from the mean for social yawns ($M = 1.31$) was indeed statistically significant, $t(84) = 3.98$, $p < 0.001$. So, overall we see a difference in the number of social and rest yawns, the difference coming mainly from obedience class observations.

CHAPTER 4

Discussio

Behavioral studies performed on animals have one unavoidable problem: at no point can we ask the animal what it was thinking when it performed the behavior. The challenge is in distinguishing communication-related behavior from normal behavior patterns (Maestripieri et al, 1992). Julie Yamane, the owner of the CLC, would sometimes use her adult male Belgian turverin as a demonstration dog while teaching her obedience classes. The dog's name was Jordy, and when she brought Jordy into the room with the rest of the class he consistently yawned at least once. Several possibilities exist for why Jordy yawned. Perhaps he was sleeping in his kennel before Julie brought him into the room and was in the process of transitioning between rest and activity. Or, being a large, dominant male dog, perhaps he sensed the discomfort his presence caused in some of the more submissive, low confidence dogs in the class. In this case, his yawns were for pacification purposes, to indicate he intended no threat. A third possibility is that Jordy himself was uncomfortable. Some of the training techniques Julie demonstrated included how to stop problem behaviors, such as a dog that jumps up on people. Using Jordy, she demonstrated how to stick your knee out when the dog jumps up. Jordy got to the point where he anticipated this event and would no longer put his forefeet upon her at this point in the demonstration. Being the demo dog meant he had to perform some behaviors he was uncomfortable with. Unfortunately, I could not question Jordy about the motivation behind his yawns, nor could I ask any of the other dogs in this study. Instead, I had to rely on the situation and surroundings the dog was in. In this way, differentiating between rest and social yawns was very much up to my own discretion, although after watching so many dogs I felt confident in distinguishing one yawn type from the other based on contextual cues.

One comment should be made about the classification of some of the rest yawns. As explained in Chapter 2, a dog that yawned while moving from an upright position to a sitting or lying position was considered to have given a rest yawn. Rugaas suggests that sitting down or lying with the belly against the ground is a signal used to calm other individuals, in which case a yawn performed along with these movements might have been social. Because determining the motivation behind sitting or lying down was too difficult, I did not account for this possibility in the study. Yawns were considered social only when paired with other, less ambiguous signals, or when the yawning dog was clearly interacting with another individual.

In categorizing the dogs into various activity levels, I was not surprised to find many of the dogs I watched falling into Level 3. The criteria for this group seem to fit the behavior pattern of most dogs. During play, the dogs were very active for a time, then the game would break up and the dogs would separate, usually going off to sit or stand until a new play session was initiated. This alternation of activity and "down time" was part of the qualification for activity Level 3. Also falling into this category were many of the obedience class dogs. On the first night of class dogs were anxious to greet and sniff the new dogs around them. I saw many instances of play solicitation between newly introduced dogs. Under normal circumstances these dogs might have fallen in Level 4, but because they were

restrained by their owners, their energy was somewhat contained, and they were placed in activity Level 3.

Out of the 84 dogs, only one dog was classified as activity Level I due to the fact she slept through her observation period. This dog was a female Husky who was afflicted with epilepsy and on a prescription drug to control her seizures. One side effect of the drug was lethargy, and she slept the majority of her time in daycare. Her complete lack of yawns should not surprise us. While sleeping, she was not performing any activities, let alone yawning. Also, if we believe the arousal hypothesis, she was remaining in the same arousal state while slumbering, so yawning to stimulate the brain for activity was not necessary. To explain the absence of yawns during sleep, Baenninger (1997) states, "This is what the amusai hypothesis would predict, since the struggle to maintain wakefulness has been abandoned by a sleeping individual."

On the opposite end of the spectrum from the non-yawners were the dogs that kept yawning again and again. The multiple yawns I observed in dogs were sometimes rest yawns, as in the case of the Labrador retriever mentioned in Chapter 3 who yawned continually while waking up from a nap. In other instances, a set of yawns had a communicative function. Examples of multiple social yawns were seen in the obedience class dogs who yawned multiple times within a period often minutes. In either type of multiple yawn, after a first yawn was given, others followed in close proximity. In Baenninger's study (1987) on yawns in different vertebrate species, he found that lions did not give multiple yawns, but that mandrills occasionally repeated their yawns after a few minutes. His study illustrated that the capacity for multiple yawns differs from species to species. I found it also differs within a species, for instance, between individual dogs. Not all of the subjects in this study gave multiple yawns. Yawning frequency varied greatly in the dogs I observed. One explanation for the variation of social yawns is that some individuals are more adept at handling novel, potentially stressful situations. Certainly not all the dogs present in the crowded waiting room yawned.

Although multiple yawns were observed from the same individual, multiple yawns did not occur between individuals. I saw no evidence that witnessing the yawn of a conspecific elicited a yawn from a dog. This phenomenon of yawn contagion is present in the human yawn reflex. Seeing, hearing or even thinking about yawning can stimulate yawns in humans (Baenninger, 1997). Reading this discussion may have elicited yawns from the reader. Humans seem to be the only species that show this trait; social contagion of yawns is absent in other species that yawn (Baenninger, 1987; Smith, 1999). Based on this information, I did not expect to see yawns of a contagious nature among the dogs. Indeed, the dogs yawned independent of each other. Dogs in close visual proximity to a yawning individual were not seen to yawn themselves. This lack of contagion was a benefit to the study, as determining if a yawn was induced by contagion or arose independently would have been impossible. Perhaps if human yawns had a communicative function we also would not show yawn contagion.

Another unexplained observation made during this study was the yawning by dogs facing the gates at the front of the room. Dogs that yawned in this situation were usually looking forward through the gates. It appeared their attention was fixed on whatever was beyond the gate. Because of this focus, I was convinced the yawns were directed at whoever or whatever had caught their attention. When someone entered the exercise mom, a short episode of mass hysteria ensued. Some dogs, in their excitement, would jump up on the fence and be scolded and sprayed with a water bottle until they complied and had all four feet back on the ground. Perhaps these yawns were given in anticipation of the period of excitement and, at times, disciplinary action that might follow.

A second possibility for social yawns in this situation was the need for signals that displace aggression among individuals in such close proximity. Reduced personal space increases the occurrence of agonistic behavior in some dogs, in which case yawns might occur for purposes of pacification in an effort to prevent such outbreaks. Ten to fifteen dogs standing on top of each other is a situation bound to cause social discomfort in some individuals. Displacement yawning may result. Besides waiting at the gate, restraint by the owner was the other situation in which I commonly saw yawns. The physical restraint observed here was more than just a human holding one end of a leash and not allowing the dog to go where it wanted. This restraint was more forceful and involved the owner holding directly onto the dog's collar or body. Smaller dogs were sometimes picked up and held in the lap. Owners wrapped their arms, even their legs, around larger dogs. In some cases, the social yawns performed in this situation were displacement activities. Dogs that were uncomfortable around strangers and had intentions of fleeing the situation were denied the opportunity to escape. A female German shepherd that was fearful of other people and dogs continually tried to pull away from the other class members. Her owner would then pull the dog back until the shepherd was again sitting at the owner's side. This tug of war continued while the dog yawned five times in response to being asked to behave counter to her internal motivation.

Pacification was the other motivation behind the yawns of some of the restrained dogs. The dogs were restrained primarily because their high levels of arousal and excitement made them uncontrollable. As a dog continued its wild behavior, the owners arousal levels also increased. Frequently the owner's voice would become more commanding and angry, the restraint on the dog more physical. This mounting aggression alone could elicit pacification behavior from a dog. In restraining their dog, owners engaged in behaviors they may or may not have realized were very dominating. For instance, owners would lean over the dog's body, placing their hands on top of the dog's head or muzzle. Pacification yawns were given by some dogs in response to the dominant postures of their owners.

After analyzing the data, many variables were shown to have no effect on the frequency of yawns overall. The first factor examined was activity level. Yawns occurred in Levels 2 through 4 as arousal levels changed or as dogs gave communicative signals. Because either yawn type was possible, we can expect that activity level would not significantly effect yawn rates. This expectation was supported by the data.

Dogs communicate with each other any time they are not sleeping, so social yawns should be observable across various levels of activity. In fact, this prediction was true, and the average number of social yawns in activity Levels 2, 3, and 4 was very similar. The expectation for frequency of rest yawns, however, was that they should be dependent on how active the dog was. In human studies, subjects who showed the lowest frequency of yawning were more active in their daily lives than high frequency yawners were (Baenninger, 1997). From this information, we might predict that rest yawns in dogs should increase as we move from high to low activity levels. The data in this study did not show this effect, and rest yawns did not vary significantly between activity levels. In his in-depth discussion of the functions of yawning, Baenninger (1997) explains that carnivorous mammals fluctuate widely between arousal levels, from low energy resting states, to hunting and killing prey items. He suggests that carnivores would need to have methods that allow them frequent shifts between arousal states. The rest yawn might serve this purpose, and dogs, being carnivorous, would show more frequent changes in arousal level than might be expected based on common sense.

In designing this study, I chose to observe settings that provided ample opportunity for social interaction between my canine subjects. Both the daycare and obedience classes were rich with potential dog and human stimuli. Analysis showed no difference in overall yawns between the two session types, meaning that whatever stimuli elicited yawns was present in both settings. In daycare, dogs interacted primarily with conspecifics. The reverse was true of obedience class. During obedience training, the human-canine interaction predominated, but in both settings, dogs were presented with social, stimulating situations. I chose these settings with the expectation that they would elicit social yawns. I was not disappointed, and average numbers of social yawns did not vary significantly between the groups.

While obedience class provided dogs with plenty of dog-dog and human-dog interaction, little time was available for sedentary, low-energy behavior. In contrast, daycare dogs were free to be as active or inactive as they chose. Dogs adapt very well to human routine, and daycare dogs are no exception. Every day at noon, the daycare dogs were kenneled and allowed to nap for a few hours. I noticed while making my observations that around 11:00 or 11:30 am, many of the dogs became restful. Less animals were involved in play; the majority were sitting or lying down on the floor. Whether this behavior was in anticipation of "nap time," because the dogs were tired from the morning's exertions, or a combination of the two, I do not know. At any rate, daycare dogs had ample time available to them for rest and relaxation. Because of this difference between daycare and obedience classes, I expected more rest yawns would appear during daycare observations. Statistical analysis showed support for this prediction. The average number of rest yawns seen in daycare compared to those seen in obedience classes was significantly different.

One of the criteria the CLC upholds for its daycare program is that all male dogs over the age of eight months must be neutered and intact females must be kept home while in heat. Because of this rule, all the sexually mature males I observed were neutered and all but a few of the females were spayed. No significant difference was shown to exist between the mean number of general yawns of male and female dogs. In non-human primates, such as

mangabeys and macaques, males were found to yawn over six times more frequently than females (Deputte, 1994). The absence of sex hormones in my canine subjects would undoubtedly rule out this effect.

Looking to canine social structure provides another possibility. The social hierarchy in a dog pack is two-part system with separate hierarchies for males and females. In sorting out dominant and subordinate relationships among themselves, female dogs would need to communicate with each other just as much as male dogs. This scenario is a possibility, albeit a weak one. The emphasis on pack structure is greatly reduced in the domestic dog due to their more stable, predictable lives (Dunbar, 1979). The domesticated dog is no longer in a life and death struggle with nature. Also, the majority of the dogs I observed in this study did not have issues with dominance.

After reviewing the literature on yawning and researching canine social behavior, I expected not to find an effect of age on yawning frequency. Puppies raised with their litter learn pacification behaviors early on to prepare them for interaction with adult dogs. Also, pacification activities can be given by dominant or subordinate individuals of any age to show that no threat is intended, or to avert aggression (Coren, 2000). Dogs of all ages find themselves in situations that cause nervousness or stress. A trip to the vet's office, the loud noises from the construction site next door, being handled by the groomer, all of these situations can stimulate displacement yawns. The results of this study indicated that no significant difference existed between the age groups of the subjects. Dogs under the age of one gave a similar number of yawns to those dogs between ages one and two, and dogs three years old or older.

The paired t-test confirmed that the difference between the number of social yawns and rest yawns was significant. However, the difference was the opposite of the original hypothesis. Social yawns were given more frequently than rest yawns, as opposed to the prediction of more rest yawns than social yawns. Part of the reason for this finding was undoubtedly the situations I chose to observe. I picked out social settings that would provide dogs with ample interaction. Obedience classes, even more than daycare, were high stress, high arousal situations for the dogs. Naturally I saw more communicative behaviors than rest related activities. If observations had been made in the dog's home or even among a small group of dogs who were already familiar with each other, I predict I would have observed more rest yawns than were seen in this study.

Overall, a difference existed between social and rest yawns, but did each observation session contribute equally to the discrepancy? Analysis of the daycare data indicated that social and rest yawns were emitted in similar numbers. As mentioned before, dogs in daycare had more chances to sit or lie down and shift their arousal levels up and down. This flexibility increased the number of rest yawns I observed, making rest yawns more even with social yawns. Also, nearly every dog in daycare attended regularly, and was therefore familiar with the routine and with the other daycare dogs. I had the opportunity to watch two or three dogs on their first day of daycare. One dog was very agitated and whined and pawed at the fence most of the time. Another dog joined right in with play and chase games. These individual

differences reiterated that some dogs take novel situations in stride, while others become stressed.

The obedience class dogs had far less opportunity to relax and transition between arousal level, resulting in yawns being skewed in the direction of social yawns. Even more than available rest time, the novelty of the situation was a major influence on the behavior of the dogs. The vast majority of dogs in these classes had never met before. As well as being around strange dogs, obedience class dogs were exposed to more human contact than the daycare animals. Owners introduced themselves and their dogs and showed much interest in meeting and petting other dogs in the class. A dog might not only be physically touched by strange humans, but he may also watch his owner give affection to other dogs. Both scenarios can cause anxiety in dogs. Obedience class was also the setting of increased physical restraint and scolding of overexcited animals, treatment that resulted in a plenitude of social yawns.

Another factor adding to the stress of obedience class was the class activity itself. The dog and owner were interacting primarily with each other, the owner asking the dog to perform behaviors that were often new to both members of the pair. The owner was challenged to figure out how to lure the dog into the desired position or behavior, the dog had to correctly guess what his owner was asking him to do. I myself have taken a dog through obedience class before and realize it can be frustrating learning new commands, as well as teaching the dog to perform a behavior it has no prior experience with. As an owner becomes frustrated, his or her agitation shows itself in body posture and in tone of voice. Dogs are naturally in tune with body language and can detect these signals long before the owner realizes she is showing her frustration. Dogs confronted with what they perceive to be an aggressive individual respond with pacification behaviors. While watching the interaction between dog and human, I commonly saw dogs turn their head away or give muzzle licks. Less often seen were yawns. Although the yawns could have been given to pacify the owner's agitation, they may instead have been displacement activities performed by a frustrated dog.

Because yawns consistently showed up during certain situations, yawning behavior could be used by owners to gauge the well-being of their dog. Let us apply this knowledge to the obedience class situation. An owner of a shy dog might watch for excessive yawning as indication of social discomfort in his or her dog. The owner could then make adjustments to help the dog feel more relaxed. For instance, the owner could move a distance away from other dogs and humans and perhaps perform some tricks with the dog to focus the animal's attention on the owner rather than on the surroundings. Rugaas suggests the human himself use calming signals on a dog, such as giving a big yawn while sitting with the dog in a stressful setting.

On the other end of the spectrum, the owner of a hyper, social dog might need to alter his or her method of restraint. An owner who feels the need to hold the dog in his or her lap or wrap their arms tightly around the animal may only be adding to the problem. Dogs can gradually habituate to being held tightly, but at first it may be uncomfortable, even threatening to the dog (Rugaas, 1997). Based on this study, I would conclude that hugging a dog tightly is a poor method of restraint, as indicated by the high number of yawns elicited. Instead, the

owner again should try to focus the dog's attention back on him or her using tricks or treats. Weather permitting, dogs can even be walked outside instead of waiting indoors. This exercise serves to dissipate some of the dog's excess energy and remove the over-stimulation of the waiting room. The bottom line is that when a dog is performing an increased number of yawns outside of sleep/wake transitions, the responsible owner should respond by helping the dog to relax and calm down.

A certain satisfaction comes from having a companion dog that understands and consistently responds to trained commands. Conversely, the human-canine bond can only be strengthened by correctly understanding and interpreting the signals dogs use when speaking to us. The yawn is a useful behavior to understand because it is an obvious behavior that can easily be seen, even from a distance. Another advantage is that the yawn is an activity humans can also perform. As Coren reminds us, "Yawning in public may be viewed as a relatively meaningless (or impolite) behavior among humans; it is conversation and conciliation when used by or directed to dogs." Perhaps in the future canine behavior modification will utilize other non-verbal signals from the canine repertoire.

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