

THUNDERSTORM PHOBIA IN DOGS

by

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Abstract

Canine thunderstorm phobia is a common, frustrating, and complex problem that, due to the often severe nature of the clinical signs, can lead to canine relinquishment to shelters. Although a potentially treatable disorder, existing treatment options have several limitations and variable success rates. Three survey-based studies were conducted to increase the knowledge base for canine thunderstorm phobia.

The first study distributed 1445 surveys through 16 Kansas veterinary clinics to determine the prevalence and characteristics of thunderstorm phobic dogs and assess differences between affected and non-affected dogs. Of 463 dogs surveyed, 240 were thunderstorm phobic as assessed by their owners. Severe weather warning systems may play a role in thunderstorm phobia. Thunderstorm phobic dogs were more fearful when exposed to tornado sirens, both during actual storms and siren testing, indicating a possible effect of classical conditioning. No differences were noted regarding sex, breed, pedigree, or neuter status. Most affected dogs preferred to be indoors remaining near their owners.

The second study distributed 1600 surveys through eight Kansas animal shelters to determine the prevalence of relinquished dogs with thunderstorm phobia. Other reasons for relinquishment were also assessed. A fear of thunder was among the least common behavioral problems leading to relinquishment in dogs. Only a quarter of owners had visited a veterinarian for assistance with behavioral problems.

The third study involved the administration of dog appeasing pheromone (DAP) in a double-blind, placebo-controlled, randomized clinical trial to assess its efficacy as a sole treatment for thunderstorm phobia. Data was collected from 60 dog owners using behavioral assessment questionnaires. In dogs given the placebo, six behaviors significantly improved, with another eleven showing a numerical trend toward improvement. However, in dogs given DAP, significant improvement was seen in three of these same behaviors. Consequently, these results do not indicate the potential use of DAP for reducing fearful behaviors associated with thunderstorm phobia when compared to negative controls.

Information gained from these studies allows veterinarians and behavioral researchers to better understand the extent of this behavioral disorder and hopefully stimulates future research to find new and more effective ways to treat it.

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Dedication

To my dog, Anna.

Afflicted with thunderstorm phobia, she has been the inspiration for studying this disorder.

Without her inspiration and unconditional love, this would not have been possible.

CHAPTER 1 - Introduction

Behavioral problems can affect our relationships with our canine companions. Some behaviors are normal for dogs, such as barking and digging, that when performed excessively can become problems for owners (Beaver, 1999, 127, 295). Others are abnormal, such as stereotypical behavior and phobias (Landsberg et al., 2003, 195; Overall, 1997, 209). Fear in animals is typically an adaptive and normal response to dangerous or threatening stimuli (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). However, fear can also be abnormal or maladaptive when it is excessive and out-of-context for a particular situation (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985a). Such is the case for thunderstorm phobic dogs. A normal, orienting response to thunder has been elicited from both thunderstorm phobic and non-thunderstorm phobic dogs; however, non-phobic dogs tend to habituate to persistent stimuli whereas phobic dogs' fear intensifies with repeated exposure to thunder (Shull-Selcer and Stagg, 1991).

Although the neurophysiology of anxiety- and fear-based disorders is not well understood, it is thought to involve the limbic system with activation of the autonomic and neuroendocrine systems (Charney et al., 1998; Overall, 2002). The fear response exhibited by dogs has behavioral, physiological, and emotional components (Shull-Selcer and Stagg, 1991). Both physiological and behavioral signs are observable, but the emotional state of animals must be inferred from behaviors. Physiological signs include dilated pupils, increased heart rate, panting, and uncontrollable elimination. Clinical signs with a greater behavioral component range from vocalizations and seeking contact from owners to escape attempts, destructiveness, and hiding.

Thunderstorm phobia in dogs is thought to be quite common, but very little data exists regarding its prevalence within a general population of dogs (McCobb et al., 2001; Overall et al., 2001). Because clinical signs are often distressing and severe, the human-animal bond is negatively affected leading to euthanasia or the relinquishment of dogs to animal shelters (McCobb et al., 2001). However, even less data exists regarding the incidence of relinquishment related to thunderstorm phobia. Despite its common and frustrating nature, minimal research has been conducted to enhance our understanding and treatment of this disorder.

Five studies have assessed thunderstorm phobia in dogs (Cottam et al., 2005; Crowell-Davis et al., 2003; Dreschel and Granger, 2005; McCobb et al., 2001; Overall et al., 2001). McCobb et al. (2001) conducted an internet survey study to discover any predispositions for the condition and learn more about clinical signs, age of onset, and attempted treatments. Another study was conducted to determine any associations between anxiety-based disorders (thunderstorm phobia, separation anxiety, and noise phobia) and the frequency of overlapping, non-specific signs (Overall et al., 2001). Dreschel and Granger (2005) took a different approach by assessing the neuroendocrine and behavioral responses of both thunderstorm phobic dogs and their owners. The other two related studies focused mainly on potential treatment options and how they affected the clinical presentation of thunderstorm phobic dogs. Crowell-Davis et al. (2003) determined that a combination of clomipramine, alprazolam, and behavior modification can be a successful treatment. A preliminary study by Cottam et al. (2005) found encouraging results relating to the use of the Storm Defender cape, which is designed to discharge static electricity build-up within canine hair that may occur during electrical storms.

Other available research relates to noise phobias (Levine et al., 2007; Seksel and Lindeman, 2001; Sheppard and Mills, 2003). Although thunderstorm phobia is considered a noise phobia, many more variables than just noise are thought to contribute to it. Atmospheric changes associated with storms may serve as primary fear-eliciting stimuli or be associated with thunder through classical conditioning (Overall, 2002; Voith and Borchelt, 1985b). Research on related topics is useful, but to truly understand or treat thunderstorm phobia, research needs to be directed specifically at the condition.

Therefore, three research studies were conducted. The first was conducted to determine characteristics of thunderstorm phobic dogs, differences between affected and non-affected dogs, and the effects of learning on its development and progression. The second was conducted to determine the relationship between thunderstorm phobia and canine relinquishment. The final study assessed the efficacy of a potential treatment for the condition.

CHAPTER 2 - You and Your Dog: A Survey of Behavior

Introduction

A research project was conducted to determine differences between thunderstorm phobic and non-thunderstorm phobic dogs. The study also determined characteristics of the sample population of thunderstorm phobic dogs. This chapter describes the importance of learning about factors affecting the development and presentation of canine thunderstorm phobia. Background information about canine thunderstorm phobia, applicable learning principles, and current treatments is reviewed. An overview containing the objectives, research design, methods, and timeline are described for this project. Finally, the results of this research are presented and discussed.

Significance of Research

Behavior is the most common reason dogs are relinquished to animal shelters or euthanized (Houpt et al., 1996; Line, 1998; Miller et al., 1996; Salman et al., 2000). Although there is no specific data on the incidence of relinquishment for thunderstorm phobia, it can result in a broken bond between owners and their dogs. Canine thunderstorm phobia is a treatable disorder (Overall, 2002; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985a); however, existing treatment options, such as behavioral modification and pharmaceutical therapy, have several disadvantages and limited success (Shull-Selcer and Stagg, 1991).

Knowing the prevalence of affected dogs and factors relating to the cause or progression of thunderstorm phobia will allow veterinarians and behavioral researchers to better understand the extent of this behavioral disorder and stimulate future research to find new ways to prevent and treat it. Characteristics specific to thunderstorm phobic dogs may reveal risk factors or

predispositions for developing thunderstorm phobia. Armed with this information, veterinarians can identify at-risk dogs to provide behavioral counseling.

Background of Research

Thunderstorm phobia is a common problem that affects many dogs and their owners in the United States and around the world (McCobb et al., 2001). For example, Shull-Selcer and Stagg (1991) determined that 87% of 30 phobic dogs at two university veterinary teaching hospitals were afraid of thunder. Although fearful and phobic dogs are frequently presented to veterinary behaviorists, there is very little data on the incidence of thunderstorm phobia, making it difficult to estimate the prevalence within the general canine population (Overall, 2002; Overall et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b).

Canine thunderstorm phobia is a complex behavioral disorder that falls within a much larger category of phobic responses to noises. Thunderstorm phobia, unlike other noise phobias (e.g., fear of fireworks or gunshots), does not merely have noise as a fear-eliciting stimulus. It may also involve other meteorological variables, such as barometric pressure, sferics (electromagnetic impulses from lightning discharges), and ozone level changes, that can act as fear-eliciting stimuli (Houtkooper et al., 1999; Overall, 2002; Voith and Borchelt, 1985b). Although thunder is thought to be the predominant stimulus causing fear in dogs, atmospheric changes affiliated with thunderstorm activity may either serve as a primary fear-eliciting stimulus or be associated with thunder via classical conditioning (Overall, 2002).

The fear response expressed by dogs afraid of thunderstorm activity involves not only a biological preparedness or innate response, but also a learned component, involving both classical and operant conditioning (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). Classical conditioning allows a dog to anticipate and plan for a potentially dangerous situation, such as thunderstorm activity (Voith and Borchelt, 1985b). The procedure of classical conditioning involves the association between two events having some relationship to one another (Frieman, 2002, 26). As a result, exposure to conditioned stimuli causes conditioned responses, or changes in an animal's behavior (Frieman, 2002, 26). In the case of thunderstorm phobia, conditioned stimuli that might become associated with thunderstorm activity could be

meteorological events (as previously mentioned), severe weather warning systems, or owners' actions preceding and during storm activity. If an association is formed between these cues and thunderstorms, the presence of the stimuli may result in a similar fear response as that produced by thunderstorms. As a result, dogs may exhibit anticipatory anxiety from exposure to conditioned stimuli, especially those occurring prior to the onset of storms.

Observational conditioning is a type of classical conditioning that allows animals to socially learn about threatening stimuli from other animals (Frieman, 2002, 276). Dogs may learn to fear thunderstorm activity from fearful companions, be it humans or dogs. In this case, the conditioned stimulus would be thunderstorm activity and the unconditioned stimulus would be the observed fearful behavior of an owner or canine housemate (Frieman, 2002, 276). Dogs undergoing this type of conditioning would then respond by also being fearful of thunderstorm activity (Frieman, 2002, 276).

Operant conditioning, which involves an association between behaviors and consequences, allows animals to become more efficient regarding the performance of behaviors and to avoid or escape potentially dangerous situations (Frieman, 2002, 133). In the case of thunderstorm phobia, two types of operant conditioning (positive and negative reinforcement) may lead to an increase in fearful behaviors. Positive reinforcement works by applying appetitive consequences to behaviors (Frieman, 2002, 145). Owners may contribute to the learning process by petting, soothing, and reassuring behaviors consistent with a fear response (Crowell-Davis et al., 2003). Removing aversive consequences for behaviors results in negative reinforcement (Frieman, 2002, 145). Two sub-types of negative reinforcement, escape and avoidance conditioning, may serve to increase escape or avoidance-type behaviors during storms (Frieman, 2002, 158). For example, a dog caught outside during a thunderstorm (aversive event) may find relief (removal of an aversive event) after pawing its way inside (behavior). The dog may then perform this behavior during future storms in the hopes of avoiding or escaping the aversive or fearful events.

Consequently, clinical signs associated with thunderstorm phobia may include escape attempts, destructiveness, and hiding. Panting, trembling, vocalizing, salivating, soliciting attention from owners, and uncontrollably eliminating are other examples of clinical signs exhibited by affected dogs (Crowell-Davis et al., 2003; McCobb et al., 2001; Overall, 2002; Overall et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). Living with dogs

that cause property damage, injure themselves, or keep their owners awake during nocturnal storm activity can have a devastating effect on the human-animal bond. This, in turn, may result in relinquishment to animal shelters or euthanasia.

Fortunately, canine thunderstorm phobia is a treatable disorder (Overall, 2002; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985a). Treatment options include behavioral modification techniques and pharmaceutical therapy. Behavior modification consists of two processes—desensitization and counter-conditioning. The first process, desensitization, decreases anxiety and fear with gradual exposure to weak, non-fearful stimuli (Voith and Borchelt, 1985b). The second behavior modification process, counter-conditioning, works by conditioning responses from a dog that are incompatible with undesirable emotional states or behavioral responses (Voith and Borchelt, 1985a, b). These two methods used concurrently may lessen a dog's response to fearful stimuli by gradually exposing the dog to non-fearful stimuli and then rewarding behaviors or emotions other than those portraying anxiety or fear. Pharmacotherapy may be a helpful adjunct, especially when behavior modification is not successful (Shull-Selcer and Stagg, 1991). Many classes of pharmaceuticals exist to treat thunderstorm phobia. These include antidepressants, anxiolytics, benzodiazepines, monoamine oxidase inhibitors, beta-blockers, phenothiazines, and anticonvulsants (Overall, 2002; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). However, these types of treatments may be difficult to implement, have variable success, and have limited empirical evidence to support their use (Crowell-Davis et al., 2003; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b).

In order to develop new and more effective treatment options, a better understanding of canine thunderstorm phobia is necessary. However, research aimed at learning about affected dogs and factors relating to the cause and progression is lacking. Only two reported studies have assessed characteristics and responses of dogs afflicted with thunderstorm phobia (Dreschel and Granger, 2005; McCobb et al., 2001). The first involved an internet study of thunderstorm phobic dog owners to determine etiologies and underlying temperaments associated with thunderstorm phobic dogs. From 69 responses, they found an over-representation of herding and rescued dogs being fearful of thunderstorms (McCobb et al., 2001). Dreschel and Granger (2005) studied neuroendocrine and behavioral responses in both thunderstorm phobic dogs and their owners exposed to simulated thunderstorms. Typical signs of fear and a 207% increase in

salivary cortisol from baseline were seen in dogs exposed to an audio recording of thunderstorm activity.

Current Study

This research project involved the distribution of a survey to owners of dogs visiting regional veterinary clinics in Kansas for routine care. The objectives of this research were to determine differences between thunderstorm phobic and non-thunderstorm phobic dogs with respect to signalment, acquisition factors, housing locations, reactions to severe weather warning systems, and interactions between owners and dogs as well as determine characteristics of thunderstorm phobic dogs.

Research Design

Project Overview

Data was collected using a cross-sectional survey-based format to query pet owners at the time their dogs were presented to a participating veterinary clinic. The project period was five months. Surveys were mailed from participating dog owners to the researcher upon completion. Cumulative data analysis was performed at the end of the five month study period.

Survey Design

The survey instrument (Appendix A) used in this project and an accompanying cover letter (Appendix A) were developed using the principles of survey development and administration for behavioral science research (Dillman, 2000). The survey questions were written in a closed-ended or partially closed-ended manner allowing for discrete data to be collected. Responses to questions were either ordered or categorical. The cover letter stated the purpose of the research project and provided information about the expectations of the respondent.

The survey design consisted of two sections, with the first being completed by owners of dogs, regardless of dogs having thunderstorm phobia. The second portion of the survey was only completed by owners of thunderstorm phobic dogs.

The survey questions were designed to gather information regarding both owner and dog reactions to thunderstorm activity. Owner-related questions referred to behaviors exhibited in preparation of storm activity, emotional states experienced during storms, the relationship between owner and dog, treatment options tried, and reactions to fearful behaviors of dogs. Dog-related questions referred to the location of the dog during preparatory behaviors, typical housing locations, reactions to severe weather warning systems, preferred locations during storms, duration and timeline of fearful behavior, behavioral responses to owner reactions, reactions to loud noises and different weather events, and clinical signs exhibited during thunderstorms. Other dog-related questions related to the signalment (age, breed, pedigree, sex, and neuter status) and acquisition factors (source of dog, reason for ownership).

Owners of multiple dogs were asked to fill out a separate survey for each dog. When doing so, owners were instructed to skip questions inclusive for the household on subsequent questionnaires. This was done to simplify the completion process for multiple dog households. To group multiple dog households' responses together, each questionnaire was assigned a unique questionnaire identification number that was affixed to the lower left corner of the title page.

Care was taken to write and construct the survey in order to minimize measurement error resulting from questions being misinterpreted or answered incorrectly (Dillman, 2000, 11). This survey was also designed to minimize nonresponse error, caused by a low response rate.

The surveys measured 7 inches by 8.5 inches. Each was copied duplex, folded into a booklet, and saddle stapled. Business-reply envelopes and the cover letters accompanied the surveys in individual 9 inch by 12 inch manila envelopes. The envelopes were sealed for distribution.

Owner Assessment of Fearful Behavior

Respondents were asked to assess their dogs' fearful behaviors in relation to thunderstorm activity and other loud noises. As dog owners are intimately familiar with their dogs' behaviors, they are acutely aware of the fearful situations that evoke them. As a result,

owners are typically accurate when observing and assessing fearful reactions of their dogs (McCobb et al., 2001; Voith and Borchelt, 1985b). Therefore, the researcher was confident that owner-based assessments would produce valid results.

Survey Distribution

Each survey packet was distributed by one of 16 participating veterinary clinics in the counties of Geary, Riley, and Pottawatomie, Kansas. Clinics were chosen based on a complete list of registered veterinary clinics provided by the Kansas Board of Veterinary Examiners and their location in the following cities: Ft. Riley, Junction City, Manhattan, Riley, and Wamego, Kansas. The survey distribution period was five months, from May 2005 to October 2005. Spring and summer months are the most common times of the year to experience thunderstorms, regardless of geographic location (Changnon, 2003). Distributing surveys during this time allowed owners of affected dogs to observe their dogs' behaviors during thunderstorm activity, thereby reducing any bias from the potential lack of recall from previous thunderstorm seasons. Survey completion was estimated to take approximately fifteen minutes. Respondents were encouraged to take the survey home to complete it. Surveys were distributed during regular operating hours which varied for each clinic. Potential subjects were not predetermined and participated on a voluntary basis. The number of surveys that were completed depended upon the number of dog owners that volunteered to participate in this study. After completion of the survey, the respondents sealed their surveys in the business-reply envelopes and mailed them back to the researcher.

At the start of the study, two thousand survey packets were distributed among the participating clinics based on estimates of patients seen at each clinic within an average two-week period. At the end of the study period, undistributed survey packets were picked up by the researcher.

Statistical Analysis

Data collected from the surveys was entered into a spreadsheet, using numerical codes for the answer choices. Not all questions were answered, which resulted in missing data. Purebred and known mixed breed dogs were classified according to breed group, which were adapted from

the American Kennel Club (American Kennel Club, 2008). Coded responses were analyzed using the SAS statistical software package (SAS Institute Inc., Cary, NC, USA).

The Wilcoxon rank sums test was used to compare the number of human and canine household members, the number of human household members fearful of thunderstorms, and the dogs' ages at neutering, acquisition, and time of survey completion between thunderstorm phobic (TP) and non-thunderstorm phobic (NTP) dogs. The chi-square test was used to test the association between TP and NTP dogs with regard to the relationship between owner and dog, storm preparation behaviors, location of dog during preparatory behaviors, owners' emotional or fearful reactions to thunderstorms, signalment characteristics (excluding age), acquisition factors, canine reactions to severe weather warning systems, and typical canine housing locations.

Other statistical analyses were performed using the Frequency Procedure of SAS. Descriptive statistics were calculated for the number of thunderstorm phobic dogs, their signalment and source, preferred locations during thunderstorms, source of diagnosis, duration and timeline of fearful behaviors, treatment options, owners' reactions to their dogs' fearful behaviors, dogs' behavioral responses to their owners' reactions, dogs' reactions to loud noises and different weather events, and clinical signs exhibited by thunderstorm phobic dogs. No comparisons were made for these factors to a non-thunderstorm phobic dog population. Percentages were calculated using the total number of completions per question. Owners were not limited in the number of diagnostic sources, preferred locations, treatment options, owner reactions, dog reactions, loud noises, weather-related events, or clinical signs they could report; therefore, statistics relating to these factors may exceed the total number of respondents.

Human Subjects Protection

The research project was conducted with approval from Kansas State University's Institutional Review Board. Owners of dogs that voluntarily participated in this study were asked to complete a survey regarding their dogs' behaviors. No consent forms were used in this study; the researcher deemed consent as the completion of the survey.

The information gathered during the course of this study was confidential. Data collected from the surveys did not have any personal identifiers attached to it, unless owners chose to provide their contact information on the questionnaire, in which case the information was only

used to send them copies of the results and was not shared with any other person or organization. Only the researcher viewed the completed surveys. All surveys have been securely stored at Kansas State University. All responses have been reported as summaries in which no individual's answers can be identified. The surveys will be stored for three years following the completion of the study before being destroyed. This study relied solely on human participants; therefore, no animal subjects protection was necessary.

Results

Survey Response

During the five-month study period, a total of 449 surveys were completed and returned by mail. Instead of completing a separate survey for each dog, ten owners used one survey for multiple dogs; the data for each dog was entered individually, yielding 463 sets of data. At the end of the study period, 555 undistributed surveys were collected from 14 of the 16 veterinary clinics. An unknown number of undistributed surveys had been thrown away by the other two participating clinics. Based on the known number of undistributed surveys, 1445 surveys were distributed during the study period. The calculated response rate for this study was 31%.

Comparison between Thunderstorm Phobic and Non-Thunderstorm Phobic Dogs

Of the surveys received, 222 (48.0%) dogs were considered by their owners to not be fearful of thunderstorms. Two hundred forty (52.0%) dogs were thought to be afraid of thunderstorm activity.

No differences were found between TP and NTP dogs regarding the number of human household members, the number of fearful human household members, or the relationship of the fearful household members to the dogs. NTP dogs were found to belong to households containing significantly more dogs (Wilcoxon, $p = 0.0001$) than TP dogs.

For many of the activities performed by owners in anticipation of a thunderstorm, there was no difference between TP and NTP dogs. The only differences observed related to watching thunderstorms approach, with significantly more owners of NTP dogs exhibiting storm watching

behavior from both inside ($X^2 = 3.9639$, d.f. = 1, $p = 0.0465$) and outside ($X^2 = 3.9303$, d.f. = 1, $p = 0.0474$) their houses. No relationship was found, however, between the performance of preparatory behaviors and the dogs being present for those activities.

Of the different emotional states of owners that were assessed in this study, only calmness and anxiety seemed to differ between TP and NTP dog owners. Being indifferent, concerned, fearful, or in a state of panic did not differ between the two dog populations. A significantly greater number of TP dogs had owners who experienced calmness to a moderate extent in relation to thunderstorm activity; whereas a significantly greater number of NTP dogs had owners who experienced calmness to a very great extent ($X^2 = 12.7217$, d.f. = 2, $p = 0.0017$). A significantly greater number of TP dogs had owners who experienced a great degree of anxiety before or during thunderstorm activity ($X^2 = 6.6272$, d.f. = 2, $p = 0.0364$).

No difference was observed between TP and NTP dogs regarding pedigree, breed, sex, or neuter status. Additionally, no difference was found regarding the source of the dogs or the reasons for ownership. The ages at neutering and acquisition were similar between TP and NTP dogs. However, TP dogs were found to be significantly older (Wilcoxon, $p < 0.0001$) at the time of survey completion than NTP dogs.

More dogs (regardless of being afraid of thunderstorms) were exposed to tornado sirens ($n = 338$) as compared to those exposed to weather radios ($n = 101$). No difference was noted between the two populations of dogs regarding whether or not they were exposed to tornado sirens ($X^2 = 1.1799$, d.f. = 1, $p > 0.05$) or weather radios ($X^2 = 0.3139$, d.f. = 1, $p > 0.05$). Differences were seen, however, regarding the dogs' reactions to each of the severe weather warning systems (Table 2.1). Significantly more TP dogs were fearful when exposed to severe weather warning systems. The onset of fearful reactions by thunderstorm phobic dogs differed between warning systems (Table 2.1). No difference was found between the two dog populations regarding unknown reactions towards the warning systems, except for dogs exposed to tornado siren testing. Significantly more NTP dog owners knew their dogs' reaction, whereas more TP dog owners were unaware of their dogs' reaction ($X^2 = 8.0364$, d.f. = 1, $p = 0.0046$).

Table 2.1 Fearful reactions by thunderstorm phobic dogs to severe weather warning systems

Reaction to severe weather warning systems	X ² ^a	d.f.	p
Fear of tornado sirens during thunderstorms	140.4141	1	<0.0001
Start acting fearful	28.9344	1	<0.0001
Already fearful, no progression	49.0323	1	<0.0001
Already fearful, with progression	22.9960	1	<0.0001
Fear of tornado siren testing	55.8032	1	<0.0001
Start acting fearful	41.6973	1	<0.0001
Already fearful, no progression	7.2236	1	0.0072
Fear of weather radio	11.7916	1	0.0006
Already fearful, no progression	8.1383	1	0.0043

^a Comparison of thunderstorm phobic and non-thunderstorm phobic dog populations

Differences were seen between TP and NTP dogs regarding typical housing locations (Table 2.2). Significantly more TP dogs were found to be housed inside while significantly more NTP dogs were housed outside.

Table 2.2 Differences between thunderstorm phobic (TP) and non-thunderstorm phobic (NTP) dogs regarding typical housing locations

Housing location	X ²	d.f.	p
TP			
Free-roaming inside during day	9.5362	1	0.0020
Free-roaming inside during night	4.3307	1	0.0374
Free-roaming inside during storm	6.7546	1	0.0094
NTP			
Crated inside during day	7.1817	1	0.0074
Outside enclosure with shelter during day	5.0545	1	0.0246
Outside enclosure with shelter during night	5.5253	1	0.0187
Outside enclosure with shelter during storm	8.7105	1	0.0032
Free-roaming outside with shelter during storm	4.9174	1	0.0266

Characteristics of Thunderstorm Phobic Dogs

The number of dogs thought to exhibit signs of thunderstorm phobia as assessed by their owners was 240. Two hundred twenty-nine (97.9%; from 234 respondents) owners diagnosed their own dogs as thunderstorm phobic; fewer had their dogs diagnosed by relatives (n = 74, 31.6%), friends (n = 47, 20.1%), or veterinarians (n = 21, 9.0%).

The frequency of signalment characteristics were calculated specifically for thunderstorm phobic dogs. Of 238 respondents indicating their dog's pedigree, 150 (63.0%) were purebred and 88 (37.0%) were mixed breed origin. Of the mixed breed dogs, 65 (27.3%) were of known breed origin. Purebred and known mixed breed dogs were classified according to breed group (American Kennel Club, 2008). Table 2.3 presents the frequencies and percentages of dogs in each breed group. Dog breeds within the sporting group were the most common breeds to be affected by thunderstorm phobia, followed by herding breed dogs.

One hundred thirty-five (56.5%; from 239 respondents) dogs were female, while 104 (43.5%) were male. A majority of thunderstorm phobic dogs were neutered (n = 203, 84.9%). Table 2.4 depicts the sex and neuter status of the thunderstorm phobic dogs from this study. The average age at the time of acquisition was less than one year of age (Table 2.5). The average age of neutering was between six months and one year of age (Table 2.6). The average age at the time of survey completion was between five and nine years of age (Table 2.7). The average age when dogs started exhibiting signs of thunderstorm phobia was one to three years (Table 2.8).

Table 2.3 Frequency of thunderstorm phobic dogs by breed group

Breed Group	n	% ^a
Sporting	77	35.6
Herding	42	19.4
Toy	35	16.2
Hound	19	8.8
Terrier	19	8.8
Working	14	6.5
Non-Sporting	10	4.6

^a Calculated based on 216 respondents indicating a purebred or mixed breed dog of known breed origin

Table 2.4 Frequency of thunderstorm phobic dogs by sex

Sex	n	% ^a
M/I	22	9.2
M/N	82	34.5
F/I	14	5.9
F/S	120	50.4

^a Calculated based on 238 respondents indicating both sex and neuter status
M = male, F = female, I = intact, N = neutered, S = spayed

Table 2.5 Frequency of thunderstorm phobic dogs by age at acquisition

Age	n	% ^a
1-6 months	161	67.6
6 months - 1 year	21	8.8
1-3 years	30	12.6
3-5 years	15	6.3
5-7 years	4	1.7
7-9 years	4	1.7
> 9 years	3	1.3

^a Calculated based on 238 respondents indicating age at acquisition

Table 2.6 Frequency of thunderstorm phobic dogs by age at neutering

Age	n	% ^a
< 6 months	37	19.3
6 months – 1 year	106	55.2
1-3 years	34	17.7
3-5 years	9	4.7
5-7 years	3	1.6
> 7 years	3	1.6

^a Calculated based on 192 respondents indicating age at neutering

Table 2.7 Frequency of thunderstorm phobic dogs by age at time of survey completion

Age	n	% ^a
1-6 months	3	1.3
6 months - 1 year	7	3.0
1-3 years	38	16.1
3-5 years	36	15.3
5-7 years	36	15.3
7-9 years	39	16.5
9-11 years	37	15.7
11-13 years	24	10.2
13-15 years	10	4.2
> 15 years	6	2.5

^a Calculated based on 236 respondents indicating age at time of survey completion

Table 2.8 Frequency of thunderstorm phobic dogs by age of onset

Age	n	% ^a
1 – 6 months	40	17.2
6 months – 1 year	50	21.6
1 – 3 years	72	31.0
3 – 5 years	35	15.1
5 – 7 years	20	8.6
> 7 years	15	6.5

^a Calculated based upon 232 respondents indicating age of onset

Two hundred thirty-nine owners of TP dogs indicated the source of obtaining their dog(s) from ten possible choices. Table 2.9 presents the frequencies and percentages pertaining to these options. More dogs were obtained from breeders and private owners than any other source. The most common sources listed as ‘other’ were from friends (n = 6) or family (n = 5).

Table 2.9 Frequency of thunderstorm phobic dogs by source of acquisition

Source	n	% ^a
Breeder	71	29.7
Private owner (non-breeder)	61	25.5
Animal shelter/Humane society	40	16.7
Other	22	9.2
Found stray	14	5.9
Breed Rescue Organization	10	4.2
Pet Store	6	2.5
Gift	6	2.5
Veterinarian	5	2.1
From owner’s litter	4	1.7

^a Calculated based on 239 respondents indicating source of acquisition

Ten locations were assessed for preference by thunderstorm phobic dogs. Of 220 respondents, 213 dogs preferred being indoors, while only 5 preferred being outdoors. Frequencies and percentages of all preferred locations are provided in Table 2.10. A large number stayed with or near their owners during storms. ‘Other’ locations indicated by owners included basements, hallways, “chasing” the sound of thunder, in the cab of a truck, and near the owner’s cat.

Table 2.10 Preferred locations of thunderstorm phobic dogs during thunderstorms

Location	n	% ^a
Indoors	213	96.8
With/Near owner	196	89.1
Constantly moving	92	41.8
Under furniture	68	30.9
Closet or dark space	42	19.1
Other	36	16.4
Crate or dog house	30	13.6
Bathtub/Shower/Sink	12	5.5
Under deck/porch	8	3.6
Outdoors	5	2.3

^a Calculated based upon 220 respondents indicating at least one preferred location for their dogs.

Six types of therapies were assessed. Fifty percent (n = 115) of owners tried to treat their dogs' fear of thunder, with most using prescription medications. The most common medication prescribed for treatment was acepromazine (n = 22), followed by diazepam (n = 3), alprazolam (n = 1), clomipramine (n = 1), and diphenhydramine (n = 1). Obedience training was used by 26.1% of owners. Frequencies and percentages of all treatment methods are listed in Table 2.11.

Other forms of treatment assessed by this study were related to owners' reactions to their dogs' behaviors. The majority of owners (n = 216, 92.3%, based on 234 respondents) reassured their dogs when fearful. Fewer owners distracted (n = 95, 40.6%), ignored (n = 66, 28.2%), and disciplined (n = 21, 9.0%) their dogs' behaviors during storms. In response to these reactions by owners, similar numbers of dogs were thought to either improve slightly or remain at the same level of fearfulness. Table 2.12 presents data regarding the dogs' responses to owner actions.

Table 2.11 Treatment methods utilized by thunderstorm phobic dog owners

Treatment	n	% ^a
Prescriptions	36	31.3
Obedience Training	30	26.1
Desensitization	25	21.7
Counter-conditioning	14	12.2
Herbal Remedies	7	6.1
D.A.P. ^b	3	2.6

^a Calculated based upon 232 respondents indicating at least one treatment option tried

^b Dog Appeasing Pheromone (Ceva Santé Animale, Libourne Cedex, France)

Table 2.12 Reactions by dogs in response to owner actions

Reaction	n	% ^a
Improve a lot	31	15.8
Improve slightly	116	59.2
Remain the same	115	58.7
Worsen slightly	8	4.1
Worsen a lot	4	2.0

^a Calculated based upon 196 respondents indicating at least one reaction

In response to being queried about when their dogs started responding fearfully towards thunderstorm activity, 103 (43.5%, based on 237 respondents) owners noticed a response prior to a storm becoming apparent to the owner, whereas 134 (56.5%) indicated their dogs responded only during thunderstorms. Of those responding fearfully prior to storms, 34 dogs started showing signs less than 30 minutes before. Forty-five dogs were thought to exhibit fearful behaviors 30 minutes to 1 hour preceding a thunderstorm. Table 2.13 presents data regarding the onset of clinical signs before thunderstorm activity.

Table 2.13 Time before thunderstorm activity when dogs exhibit fearful behavior

Time	n	% ^a
< 30 minutes	34	33.0
30 minutes – 1 hour	45	43.7
1 – 3 hours	18	17.5
3 – 5 hours	4	3.9
> 5 hours	1	1.0

^a Calculated based on 103 respondents indicating time to onset preceding thunderstorms

Eight different weather-related events and seven loud noises were assessed as possible fear-eliciting stimuli. Table 2.14 presents data regarding these assessments. The majority of dogs were found to be fearful to some degree of weather-related events containing thunder, either alone (96.7%) or in combination with rain (97.1%) or lightning (97.9%).

Fewer dogs were afraid to some degree of hail (68.8%), heavy rain (64.6%), and lightning alone (63.3%). Wind (34.6%) and light rain (35.8%) elicited fearful behaviors in a third of dogs. Of the other loud noises assessed, more dogs were found to be fearful to some degree of fireworks (86.3%), followed by vacuum cleaners (63.8%), gun shots (44.6%), and Ft. Riley artillery bursts (41.3%). Cars backfiring elicited fearful behaviors to some degree in 38.3% of dogs. The least fear-evoking stimuli were planes (10.4%) and other loud noises

(10.8%). Examples of ‘other’ noise-related fearful stimuli included lawnmowers (n = 4), emergency sirens (n = 4), yelling/screaming (n = 3), trains (n = 3), any loud noise (n = 3), motorcycles (n = 2), slamming doors, shaking plastic bags, noises on roof, pastures burning, honking, clapping, and the Ft. Riley bugle.

Table 2.14 Weather-related events and loud noises eliciting fearful behaviors in dogs by type of response elicited

	n1	% ^a	n2	% ^a	n3	% ^a	n4	% ^a	n5	% ^a
Weather										
Wind	150	62.5	48	20.0	30	12.5	5	2.1	1	0.4
Hail	47	19.6	65	27.1	59	24.6	41	17.1	21	8.8
Light rain	149	62.1	59	24.6	21	8.8	6	2.5	1	0.4
Heavy rain	78	32.5	59	24.6	70	29.2	26	10.8	0	0.0
Rain/thunder	7	2.9	31	12.9	72	30.0	130	54.2	0	0.0
Thunder alone	7	2.9	21	8.8	76	31.7	135	56.3	0	0.0
Lightning/thunder	3	1.3	16	6.7	64	26.7	155	64.6	0	0.0
Lightning alone	69	28.8	61	25.4	59	24.6	32	13.3	13	5.4
Noises										
Fireworks	18	7.5	24	10.0	66	27.5	117	48.8	15	6.3
Gun shots	32	13.3	17	7.1	31	12.9	59	24.6	99	41.3
Cars backfiring	47	19.6	29	12.1	41	17.1	22	9.2	96	40.0
Vacuum cleaners	76	31.7	62	25.8	55	22.9	36	15.0	4	1.7
Ft. Riley artillery	103	42.9	47	19.6	29	12.1	23	9.6	34	14.2
Planes	177	73.8	20	8.3	4	1.7	1	0.4	34	14.2
Other	18	7.5	5	2.1	9	3.8	12	5.0	17	7.1

^a Calculated based upon 240 respondents indicating type of reaction to at least one noise or weather event
n1 = no reaction; n2 = mild reaction; n3 = moderate reaction; n4 = severe reaction; n5 = unknown reaction

Twenty-two clinical signs were assessed. The most commonly observed sign was remaining near the owner, followed by increased alertness, shaking/trembling, panting, and soliciting attention from owners. Howling, unresponsiveness, uncontrollable elimination, self-injury, and collapsing were seen in less than 10% of dogs. Table 2.15 presents frequencies and percentages for each clinical sign.

Table 2.15 Frequency of clinical signs exhibited by thunderstorm phobic dogs

Behavior	n	% ^a
Remaining Near Owner	218	92.4
Increased alertness	210	89.0
Shaking/Trembling	186	78.8
Panting	180	76.3
Soliciting Attention	168	71.2
Increased Activity	156	66.1
Hiding	133	56.4
Whimpering/Whining	130	55.1
Barking	83	35.2
Excessive salivating	74	31.4
Lip Licking	70	29.7
Escape attempts	64	27.1
Decreased Activity	48	20.3
Yawning	47	19.9
Dilated Pupils	35	14.8
Destructiveness	28	11.9
Howling	23	9.7
Unresponsiveness	22	9.3
Uncontrollable urination	12	5.1
Self-Injury	9	3.8
Uncontrollable defecation	6	2.5
Collapsing	2	0.8

^a Calculated based on 236 respondents indicating at least one clinical sign

Discussion

In the population of dog owners sampled, roughly half (52.0%) owned thunderstorm phobic dogs, while the other half (48.0%) owned non-thunderstorm phobic dogs. As owners of thunderstorm phobic dogs may have been more inclined to participate in this study, this value may be over-inflated. Nevertheless, this gives an idea of the prevalence of this behavioral problem within this sample population as assessed by owners.

This study sought to determine if social learning influenced the development or progression of thunderstorm phobia. When comparing TP to NTP dogs, no relationship was found between fearful owners and TP dogs. No differences were found between the two dog populations relating to the number of fearful owners in a household or their relationship with

their dogs. As such, observational conditioning from humans does not seem to contribute to thunderstorm phobia.

There was a difference relating to the number of dogs in the household, however, with NTP dogs being part of larger multiple-dog households than TP dogs. Dreschel and Granger (2005) found TP dogs in multiple-dog households to have a smaller increase in salivary cortisol from baseline to post-exposure compared to dogs in single-dog households when exposed to a simulated thunderstorm; however, no behavioral differences were seen between dogs in single and multiple-dog households. Their research may indicate a less extreme stress response in TP dogs living with other dogs. As more non-fearful dogs from the current study were living with other dogs, it is possible that being a part of multiple dog households can positively affect the fear and stress responses of dogs caused by thunderstorm activity. Consequently, observational conditioning between dogs may influence fear responses associated with thunderstorm phobia, but in an opposite direction as originally thought, with dogs potentially learning not to be fearful. Further research is necessary to determine specific factors related to inter-dog influences on thunderstorm phobia.

To the author's knowledge, this was the first study to evaluate owner preparatory behavior. Of the many different behaviors that owners might engage in prior to the onset of a thunderstorm, only observing thunderstorms differed between TP and NTP dog owners, with the latter being more likely to watch an impending storm front from both inside and outside their homes. Despite this difference, there was no relationship found between storm preparatory behaviors being performed by owners and the dogs being present for any of those activities. TP dogs are no more likely than NTP dogs to react to behaviors performed by their owners in anticipation of a storm. Therefore, there was no evidence that owners' preparatory behaviors were associated with thunderstorm activity through classical conditioning.

The difference seen between TP and NTP dogs and their owners watching incoming storms may relate to the emotional states of the owners. Owners of TP dogs were found to have a lesser degree of calmness and a greater degree of anxiety as compared to owners of NTP dogs. The emotional states of the owners may influence the owners' behaviors during storms and may impact the emotional states of the dogs via classical conditioning. Dogs may be associating their owners' moods with thunderstorm activity. Dreschel and Granger (2005) found owners' moods to affect how they behaved towards their dogs; however, they did not find any effect from

owners' moods or behavior on thunderstorm phobic dogs' responses. In contrast, the dogs' fearful behaviors during thunderstorms may influence the emotional states of their owners, although previous research has not found a negative effect of canine fearful behavior on caregivers (Dreschel and Granger, 2005).

Dogs' exposure to severe weather warning systems was assessed in this study, with no difference being found between TP and NTP dogs. However, more dogs in general were exposed to tornado sirens versus weather radios. This difference may result from weather radios being less common in households, and dogs living within cities employing public safety systems, such as tornado sirens, increasing their exposure to them.

Differences were seen between TP and NTP dogs regarding their reactions to severe weather warning systems. TP dogs were found to be more fearful during tornado sirens and weather radios during actual storm events; these dogs may be more fearful because of the thunderstorm activity or the warning systems themselves. Interestingly, TP dogs were also more likely to be fearful of tornado siren testing, occurring in the absence of thunderstorms. The latter may be due to a fear of the siren noise itself or anticipatory anxiety via classical conditioning, in which the dogs associated tornado sirens with thunderstorm activity.

TP dogs' fearful reactions in response to tornado sirens during thunderstorms were either to start being fearful or they already were fearful (and either remained at the same level of fearfulness or progressed to being more fearful). Those that started acting fearfully or progressed to a more fearful level may have been influenced by either the siren sounding or their owners' emotional states. The siren itself may be loud enough to evoke fear or may serve as a cue to dogs of worsening weather conditions (i.e. more lightning, louder thunder, stronger winds) via classical conditioning. Tornado sirens during actual storm events signify a strong possibility of tornadic weather. Owner emotional states becoming more fearful in anticipation of a tornado may impact the dogs' emotional states via classical conditioning. TP dogs fearful in response to an activated weather radio during a thunderstorm were already fearful and remained at the same level of fearfulness. It is possible that weather radio output does not have as strong an effect on the behavioral responses of dogs or the emotional states of owners, accounting for the absence of fear progression.

The relationship between housing and being thunderstorm phobic was assessed. More TP dogs were found to reside indoors and have free access to areas of their owners' houses

during thunderstorms. More NTP dogs were housed outdoors (either free-roaming or in an enclosure) with access to shelters during storms. This difference may relate to NTP dogs being more comfortable outdoors during storm conditions as compared to TP dogs. As more TP dogs were also housed inside during typical days and nights and preferred to be indoors during thunderstorms, it is possible that owners of TP dogs house them indoors indefinitely to ensure the dogs' comfort in case of storm events occurring.

No differences were seen between TP and NTP dogs regarding their signalment (sex, neuter status, pedigree, breed, age at neutering) or acquisition factors (source of dog, age at acquisition). One difference noted, though, related to the age of dogs at the time of survey completion. TP dogs were found to be significantly older than NTP dogs. The reason for this finding is unclear.

The previously discussed information is important in understanding differences between TP and NTP dogs and in understanding what factors may affect the development or progression of canine thunderstorm phobia. Other variables were also studied specifically within the TP dog population to gain a better understanding of the dogs affected by this condition.

The majority of dogs identified as being thunderstorm phobic were done so by their owners. This indicates the ease with which owners can identify dogs with this condition. Only nine percent of owners felt their dogs were diagnosed professionally by veterinarians. Despite this, 31% of owners were given prescription medications from their veterinarians for treating their dogs' fear of thunder. Acepromazine, a phenothiazine sedative, was the most common medication prescribed to treat thunderstorm phobia. On the contrary, it increases an animal's reactivity to loud noises, making it an undesirable medication for treating noise phobias (Crowell-Davis and Murray, 2006, 152; Overall, 2002, 2001). An even smaller number of owners tried desensitization or counter-conditioning as a treatment option for their dogs. These results indicate the need for veterinarians to become more involved in assessing thunderstorm phobia in their patients, to have a better understanding of appropriate medications for treatment, and to understand the concepts of behavioral modification in order to provide behavioral counseling.

Most owners reassured their dogs during storms. This may indicate an innate need of humans to comfort their pets, although it has been suggested that reassuring dogs can reinforce fear-related behaviors (Crowell-Davis et al., 2003; McCobb et al., 2001). Despite the type of

reaction owners had to their dogs' behaviors, most owners thought their dogs' behaviors were either unaffected or slightly improved. If anything, the principles of operant conditioning would dictate that reinforcement would increase the fearful behaviors, making the problem worse. However, some believe reassurance is necessary to calm pets using classical counter-conditioning (Animal Behavior Associates, 2007). Instead of rewarding fearful behaviors, classical conditioning is used to alter the fearful emotional state (Animal Behavior Associates, 2007). In order for this to be successful, however, owners would need to be inherently calm themselves. Reassurance resulting in unchanged or improved behaviors in this study is inconsistent with the emotional states of TP dog owners as discussed earlier.

Similar to other literature (McCobb et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b), no sex predilection was found within TP dogs with nearly equal distributions of both, indicating that sex has little to do with the development of thunderstorm phobia.

Voith and Borchelt (1985b) indicated no breed predisposition for phobias, but McCobb et al. (2001) found herding (n = 19, 40%) and hound (n = 10, 21%) breeds to be overrepresented in their study. Unfortunately, their results could be biased based upon the sample population of respondents to their survey (McCobb et al., 2001). Although the current study also found a high number of herding breeds, the most common breeds affected were within the sporting group. Hound breeds represented the fourth most common breeds affected. Despite similarities between these studies, the current study found no differences between TP and NTP dogs relating to breed, indicating little, if any, role of breed in the development of thunderstorm phobia. Regional and national dog ownership statistics were unavailable for comparison.

Other studies have assessed the age of onset of thunderstorm phobia-related clinical signs finding differing results (McCobb et al., 2001; Shull-Selcer and Stagg, 1991). Shull-Selcer & Stagg (1991) suggested the age of onset was greater than one year of age. McCobb et al. (2001), however, found the most common age of onset to be less than one year of age (n = 17, 42%). Although results from the current study indicate the average age of onset of thunderstorm phobia was between one and three years of age, 39% were less than one year old when thought to first exhibit signs.

The majority of TP dogs in the current study came from breeders, private owners, and shelters/rescues, consistent with results found by McCobb et al. (2001). It is possible that the dogs adopted from shelters or rescues have had previous aversive experiences predisposing them

to exhibit more anxiety-related behavioral conditions (McCobb et al., 2001). However, a greater number of TP dogs in the current study came from professional breeders and private owners who were more likely to provide non-aversive developmental environments for their dogs.

Of the locations where TP dogs preferred to reside during thunderstorms, simply being indoors was the most prevalent. This may indicate an innate adaptive response of dogs to avoid or escape fear-eliciting stimuli. Other locations providing a similar refuge from thunderstorms that were preferred by dogs included hiding under furniture, in dark spaces, in crates or dog houses, and under decks/porches. Although not well understood, dogs seeking refuge in bathrooms is unique to thunderstorm phobic dogs and could relate to static electrical charges in the atmosphere generated from lightning (Dodman, 1996, 135-136; McCobb et al., 2001).

Anecdotal evidence suggests animals can predict weather-related changes and thus respond behaviorally prior to such events. Unfortunately, it is difficult to study such claims as weather-related events are random and often unpredictable. Despite this, owners were asked when their dogs exhibited signs of thunderstorm phobia in relation to the onset of thunderstorms. Forty-four percent of owners thought their dogs started responding before storms, with less than one hour preceding the storm being the most common time to onset of clinical signs. As this is the result of owners' opinions, further research is needed to assess the validity of these results.

Not surprisingly, when assessed regarding different weather-related variables, nearly all thunderstorm phobic dogs were afraid of conditions with thunder. Hail and heavy rain often involve loud noises as well, but elicited fearful responses in fewer dogs; the condition involving lightning without thunder accounted for a similar number of fearful responses from dogs. Several plausible reasons may account for this. First, lightning may be a primary fear-eliciting stimulus. Second, it is possible that dogs acting fearfully toward lightning alone have formed an association between lightning and the typically resulting clap of thunder. Through classical conditioning, dogs may experience anticipatory anxiety as a result of observing lightning. The third possible reason is purely speculative, but dogs might be able to hear or sense thunder associated with lightning when it is not audible to humans. Unlike thunder, wind and light rain are often more quiet in nature and elicited fearful responses in only a third of TP dogs.

Dogs afraid of thunder are likely to also be afraid of other loud noises, possibly as a result of stimulus generalization (Overall et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). In the current study, fireworks, vacuum cleaners, gun shots, and artillery

bursts from Ft. Riley, KS, were among the most common noises to elicit fear in TP dogs. As the dogs assessed for fear of other loud noises were all considered thunderstorm phobic by their owners, it is not surprising that more owners were aware of their dogs' responses to weather-related events as compared to other loud noises. As a result, anywhere from 2 to 41% of owners were unaware of their dogs' reactions to loud noises other than thunder.

Common clinical signs of thunderstorm phobia include attention-seeking behaviors, hiding, remaining near owners, increased vigilance, trembling, vocalizing, panting, salivating, trying to escape, destructiveness, and uncontrollable elimination (Crowell-Davis et al., 2003; McCobb et al., 2001; Overall, 2002; Overall et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). The most common clinical sign exhibited by the dogs from the current study was remaining near their owners. Other very common signs included increased alertness, shaking/trembling, panting, soliciting attention, increased activity, and hiding. Behaviors seen to a much lesser degree were howling, unresponsiveness, uncontrollable elimination, self-injury, and collapsing. These results are consistent with other studies (Crowell-Davis et al., 2003; McCobb et al., 2001), but were collected from a larger population of TP dogs allowing for a better understanding of canine thunderstorm phobia.

There were two limitations of this study. First, since only 16 veterinary clinics participated in this study, some sampling error occurred because not every dog owner was surveyed. However, having a large sample size from which to draw inferences about the survey population minimized the amount of sampling error.

Second, even though care was taken to design a survey with minimal measurement error, several potential sources were identified. For example, some questions (i.e. those inquiring about the age of the pet) should have included 'unknown' or 'not applicable' answer choices. By omitting these choices, respondents either made notes in the margin of the survey or left questions blank. Another example relates to the last question of the survey. This question's unique format seemed to confuse some respondents. Therefore, the type of information gathered from this question was reduced to simple frequency of performance instead of including behavior intensity. Future studies should use surveys that prevent these types of measurement error. Nevertheless, the data from this study is useful in understanding the dogs affected by canine thunderstorm phobia and how they compare to non-thunderstorm phobic dogs.

Conclusion

Roughly half of the population sampled in this study owned thunderstorm phobic dogs, allowing veterinarians and researchers to better understand the scope of this problem. This may be one of the first surveys to assess any potential learning that may occur between thunderstorm phobic dogs and housemates (human or canine). Observational conditioning between owners and dogs did not appear to affect the development or progression of thunderstorm phobia. However, dogs living in multiple-dog households were less likely to be affected by thunder. Tornado sirens may influence thunderstorm phobia through classical conditioning.

Of affected dogs, nearly equal distributions of those responding fearfully before and during thunderstorms were found. This may indicate the ability of dogs to detect weather-related changes associated with thunderstorms before their actual onset.

Many owners of affected dogs reassured their dogs during thunderstorms. Prescription medication was the most commonly utilized form of therapy, with acepromazine, an inappropriate medication, being the most frequently prescribed (Crowell-Davis and Murray, 2006, 152; Overall, 2002, 2001).

Other characteristics of thunderstorm phobic dogs assessed in this study reinforced those found in previous literature (McCobb et al., 2001; Overall et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). No sex or breed predispositions were detected. Similar age of onset, source of acquisition, and clinical signs were observed in this sample population as in other studies (Crowell-Davis et al., 2003; McCobb et al., 2001; Shull-Selcer and Stagg, 1991). Dogs with thunderstorm phobia were also likely to exhibit fears of other loud noises (Overall et al., 2001).

CHAPTER 3 - Why Dogs are Put up for Adoption

Introduction

A research study was conducted primarily to determine the prevalence of dogs relinquished to Kansas animal shelters due to the inability of their owners to cope with the various manifestations of thunderstorm phobia. The study also determined the prevalence of behavioral and non-behavioral reasons for relinquishment and characteristics of surrendered dogs. This chapter describes the importance of determining this information in order to promote strategies aimed at reducing the number of dogs relinquished to shelters. Background information about behavioral-related relinquishments, veterinary involvement in reducing relinquishments, and canine thunderstorm phobia is reviewed. An overview containing the objectives, research design, methods, and timeline are described for this project. Finally, the results of this research are presented and discussed.

Significance of Research

Canine thunderstorm phobia is a common problem that affects many dogs, and thus their owners, in the United States and around the world (McCobb et al., 2001). For example, current research found 52% of dogs to be thunderstorm phobic (see Chapter 2). Unfortunately, objective data on the prevalence of thunderstorm phobia related to canine relinquishment is not available.

Canine thunderstorm phobia is a treatable disorder (Overall, 2002; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985a). Treatment options include behavioral modification techniques and pharmaceutical therapy. However, they have had limited success and can be difficult to implement (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). These disadvantages make them less than ideal in treating this condition. More research is needed to

identify additional treatment options. Knowing the prevalence of relinquishment for thunderstorm phobic dogs will allow veterinarians and behavioral researchers to better understand the extent of this behavioral disorder and stimulate future research to find new ways to prevent and treat it. Armed with information, veterinarians can identify individual at-risk dogs in order to provide behavioral counseling and treatment before the problem becomes established and leads to relinquishment.

Background of Research

Dogs are relinquished to animal shelters for several reasons, which may be behavioral or non-behavioral; however, undesirable behavior is the most common reason for relinquishment (Houpt et al., 1996; Line, 1998; Miller et al., 1996; Mondelli et al., 2004; Salman et al., 2000; Salman et al., 1998; Shore, 2005; Wells and Hepper, 2000; Weng et al., 2006). The number of dogs and cats in animal shelters is overwhelming with an estimated six to eight million being relinquished every year, and of these, nearly half will be euthanized (The Humane Society of the United States, 2008). Fifty to seventy percent of canine euthanasias are estimated to be the result of behavioral problems (Salman et al., 2000). This is an unfortunate ending for these dogs, especially since many pets euthanized in shelters have treatable behavioral disorders (Salman et al., 2000).

There is evidence that early intervention and veterinarian involvement has potential for raising owner awareness of behavioral problems and impacting relinquishment to shelters. A case-control survey study designed to assess risk factors for relinquishments found that owners that had received advice from their veterinarian were less likely to relinquish their dog (Patronek et al., 1996). Additionally, the study found that only a small percentage (25%) of owners had been offered regular behavioral advice from their veterinarian. Another study underscored the need for an increased role of veterinarians in behavioral counseling. This survey found that only a small percentage (15.4% and 14.5% for female and male veterinarians, respectively) routinely discussed animal behavior during annual examinations (Patronek and Dodman, 1999). According to this survey, animal behavior was more likely to be discussed during new puppy/kitten or new adult pet examinations (Patronek and Dodman, 1999). Perhaps the most

telling observation was that only 11.1% of all responding veterinarians “strongly agreed that it was a veterinarian’s responsibility, rather than a client’s, to initiate discussion about behavior problems” (Patronek and Dodman, 1999, 1608). While the problem of behavioral relinquishments is of large scope and much remains to be done, it is apparent from these few studies that veterinarians must become more comfortable with integrating behavioral counseling into their practice.

Research into the social, environmental, and medical aspects of canine behavior disorders is an important part of educating veterinarians about the problem of canine relinquishments. Veterinarians need to become familiar with the identification and management of behavioral disorders.

Several studies have investigated the reasons for relinquishment of dogs to animal shelters, but few have assessed fear as a potential reason. Both Miller et al. (1996) and Line (1998) conducted survey studies to evaluate behavioral and non-behavioral reasons. Line (1998) found aggression and hyperactivity to be common behavioral reasons, but did not report results pertaining to fearfulness (Line, 1998). Miller et al. (1996) cited specific behavioral reasons as hyperactivity, housetraining problems, destructiveness, fearfulness, and barking, but did not report the percentage of dogs relinquished for fearfulness (Miller et al., 1996).

Another study utilized a questionnaire that listed a possible 71 reasons for relinquishment, with 24 being behavioral in nature (Salman et al., 2000). Only one behavioral reason consisted of fearfulness, but did not indicate any specific stimuli for causing fear (Salman et al., 2000). This report did not indicate the percentage of dogs relinquished for fearful behavior (Salman et al., 2000). However, an earlier report indicated that 31% of surrendered dogs acted fearful at some level (Salman et al., 1998).

Canine thunderstorm phobia is a complex behavioral disorder with non-specific clinical signs ranging from panting, shaking, and hiding to vocalizations, elimination, and destructive behavior. Living with dogs that cause damage to property and/or harm themselves can have a powerful and exasperating effect on the human-animal bond, which may be broken because of the unwanted behavior exhibited by affected pets. This resulting break can lead to the relinquishment of these dogs to animal shelters. However, no reported study has examined thunderstorm phobia as a possible reason for relinquishment.

Current Study

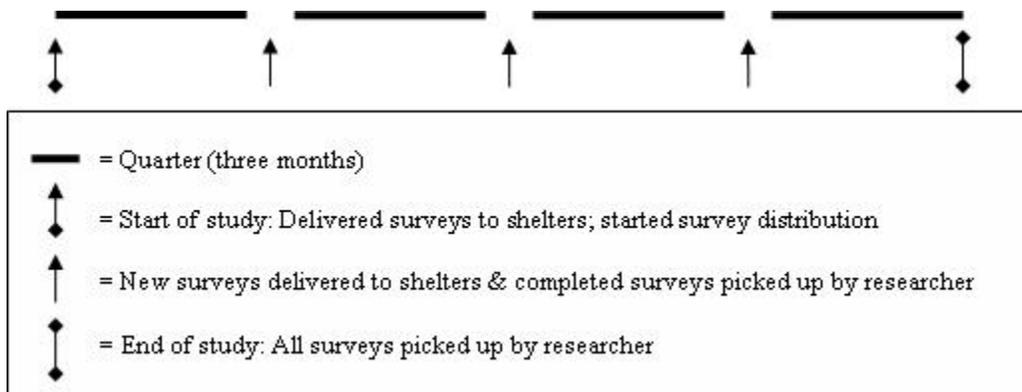
This research study involved the distribution of a survey to owners of dogs that relinquished them to participating animal shelters in the state of Kansas. The primary objective of this research was to determine the frequency of dogs with thunderstorm phobia relinquished to animal shelters. Other objectives sought to determine the frequency of dogs relinquished with other reasons, including behavioral disorders, as well as the characteristics of relinquished dogs.

Research Design

Project Overview

Data was collected using a cross-sectional survey-based format to query pet owners at the time their dog(s) was surrendered to a participating animal shelter. The project period was 12 months to account for any seasonal variations in relinquishment reasoning (Figure 3.1). Surveys were collected from participating animal shelters quarterly (every three months). Cumulative data analysis was completed after the end of the one-year study period.

Figure 3.1 Project timeline



Survey Design

The survey instrument (Appendix B) used in this project and an accompanying cover letter (Appendix B) were developed using the principles of survey development and administration for behavioral science research (Dillman, 2000). The survey questions were written in a closed-ended or partially closed-ended manner allowing for discrete data to be collected. Responses to questions were either ordered or categorical. The survey was designed to collect information to describe dogs surrendered to animal shelters. The cover letter stated the purpose of the research project and provided information about the expectations of the respondent.

Ten reasons for relinquishment and 17 behavioral problems were chosen for assessment based on typical reasons cited by owners in similar studies (Miller et al., 1996; Patronek et al., 1996; Salman et al., 2000). Even though the main objective of this study was to determine the frequency of dogs surrendered with thunderstorm phobia, other reasons for relinquishment (both behavioral and non-behavioral) were included as answer choices. This was done in an attempt to reduce any bias that might have occurred had only one reason for relinquishment been offered to respondents. Additional questions gathered specific information about behavioral problems, such as who diagnosed the problems, any attempted treatments, and whether or not a veterinarian was consulted.

Other questions were designed to gather information about the signalment (age, breed, sex, and neuter status) of the relinquished dogs, the place from which the dogs were obtained, the costs of the dogs, why the dogs were obtained, if they received any obedience training or veterinary care, and if there were any other remaining pets in the households.

Care was taken to write and construct the survey to minimize measurement error resulting from questions being misinterpreted or answered incorrectly (Dillman, 2000, 11).

This survey was designed to minimize nonresponse error, caused by a low response rate (Dillman, 2000, 11). The survey was short, taking less than five minutes to complete, and designed to be completed in the time it took to process animal shelter relinquishment paperwork. Since it could be returned before leaving the shelter, there was no additional effort required on the part of the respondents to place the survey in the mail or pay for postage. Additionally, the answers were anonymous to help prevent any social risks that could have been involved in completing the survey.

The surveys measured 5.5 inches by 8.5 inches. Each was copied duplex, folded into a booklet, and saddle stapled. The cover letters were Z-folded and accompanied the surveys in individual 6 inch by 9 inch manila envelopes. The envelopes were left unsealed for distribution.

Owner Assessment of Behavioral Problems

This study relied on dog owners' reports of behavior problems (e.g. thunderstorm phobia, human-directed aggression, and inappropriate elimination) as their perception determined whether or not a dog was surrendered (Wells and Hepper, 2000). Most owners are aware of what constitutes fearful and aggressive behavior, and what stimuli might elicit these behaviors (Voith and Borchelt, 1985b). Owners are also aware of when their pets experience house-training mistakes by urinating or defecating in their house. As a result, the researcher was confident that this survey would produce valid information regarding canine behavioral problems as assessed by owners.

Survey Distribution

Each survey packet was distributed by one of eight participating animal shelters in the state of Kansas. Shelters were chosen based on the population estimates of the area for which they served (U.S. Census Bureau, 2008); in order to increase the number of potential respondents, shelters serving largely populated areas, and potentially receiving more relinquishments, were chosen. Survey completion was estimated to take less than five minutes allowing respondents adequate time to complete the survey while their relinquishment paperwork was processed by the animal shelter staff. Surveys were distributed during regular operating hours which varied for each shelter. Potential subjects were not predetermined and participated on a voluntary basis. The number of surveys that were completed depended upon the number of dog owners that volunteered to participate in this study. After completion of the survey, the respondents sealed their surveys in the manila envelopes and placed them into return boxes provided for each shelter to ensure complete anonymity.

A short pilot study was conducted for two weeks in October 2005 to determine an approximate response rate for survey completion from the eight participating animal shelters.

Based on the number of completed surveys received from each shelter during the pilot period, an estimate of 1600 was calculated for the number of surveys required for a 12-month project.

The most common reason for refusal to complete the survey during the pilot study was fear of a breach of anonymity, with answers affecting the potential adoption of the pet being surrendered. As a result of this finding, additional precautions were taken during the study to increase the response rate. Owners were encouraged to complete their survey in each shelter's waiting area, away from the front desk, by using a clipboard. Owners were also encouraged to seal their survey within the manila envelope prior to their placing it in the return box. A poster indicating the survey's anonymity was placed at each shelter to promote participation.

Fifty survey packets were initially delivered to each animal shelter two days prior to the start of the study. Each shelter also received a return box with which to collect completed surveys, two clipboards, ink pens, information to distribute among shelter workers informing them of the study and their role in it (Appendix C), and a small self-standing poster (Appendix C) displaying information regarding the study.

Upon picking up completed surveys at the end of each 13-week quarter, the researcher provided the shelters with additional blank surveys to use during the next quarter of data collection. The final day of survey distribution was the last day of the fourth quarter. At the end of the fourth quarter (and the 12-month project period), the researcher picked up all surveys (blank and completed), survey collection boxes, clip boards, and display posters.

Statistical Analysis

Data collected from the surveys was entered into a spreadsheet, using numerical codes for the answer choices. Not all questions were answered yielding missing data. Purebred and known mixed breed dogs were classified according to breed group, which were adapted from the American Kennel Club (American Kennel Club, 2008). Coded responses were analyzed using the Frequency Procedure of the SAS statistical software package (SAS Institute, Inc., Cary, NC, USA).

Descriptive statistics were calculated for relinquishment reasons, behavioral problems and related information, pedigree, breed group, sex, neuter status, age, source, cost, reason for ownership, obedience training, veterinary care, and ownership of other household pets.

Percentages were calculated using the total number of completions per question. No comparisons were made to a general pet-owning population due to the descriptive nature of the study.

Human Subjects Protection

The research project was conducted with approval from Kansas State University's Institutional Review Board. Owners of dogs that voluntarily participated in this study were asked to complete a survey regarding their dogs' relinquishment. No consent forms were used in this study; the researcher deemed consent as the completion of the survey.

The information gathered during the course of this study was anonymous, with absolutely no way to connect owners with specific answers, to avoid social stigma accompanying the relinquishment of a pet to an animal shelter. Data collected from the surveys did not have any personal identifiers attached to it. Only the researcher was privileged to review the completed surveys. All surveys have been securely stored at Kansas State University. All responses have been reported as summaries in which no individual's answers can be identified. The surveys will be stored for three years following the completion of the study before being destroyed.

This study relied solely on human participants; therefore, no animal subjects protection was necessary. The completion of these surveys did not affect the outcomes (adoption or euthanasia) of the relinquished dogs.

Results

Survey Response

During the 12-month study period, a total of 229 surveys were completed and returned to the boxes in the eight participating shelters. Instead of completing a separate survey for each dog, three owners used one survey for multiple dogs; the data for each dog was entered individually, yielding 232 sets of data. Since each shelter began each quarter of the study with 50 blank surveys, the response rate for this study was 14.3%.

Reasons for Relinquishment

Ten reasons for relinquishment were assessed. Owners were not limited in the number of reasons they could report for relinquishing their dog(s); therefore, the total may exceed the total number of respondents. Table 3.1 presents the frequencies and percentages for each reason. Relinquishment of an unwanted litter was cited as the highest reason for relinquishment, followed by behavioral problems and the owner moving to a different location. The most frequent reasons listed as ‘other’ were the owner moving to a nursing home or having passed away (n = 4) and the owner working too much to adequately care for a pet (n = 3). ‘Other’ reasons listed less frequently included shedding too much hair; deploying overseas; inability to produce puppies; landlord regulations; not getting along with other dogs, owner, or children; lack of adequate space for dog; and no longer wanting dog for unspecified reasons. Since owners surrendering unwanted litters were not asked to complete the remainder of the questionnaire, these surveys were excluded from the remainder of the analyses.

Table 3.1 Frequency of reasons for canine relinquishment

Reason for Relinquishment	n	% ^a
Unwanted litter	53	22.8
Behavior problem	45	19.4
Moving	39	16.8
Too much work	32	13.8
Time-consuming	26	11.2
Other	20	8.6
Owner illness	19	8.2
New baby	18	7.8
Dog old age	15	6.5
Too expensive	14	6.0

^a Calculated based upon 232 sets of data from 229 completed surveys

Behavioral Problems

A total of 127 respondents indicated that their dog had at least one behavioral problem. Owners were not limited in the number of behavioral problems they could report; therefore, the total may exceed the total number of respondents. Table 3.2 presents the frequencies and percentages for each behavioral problem. The problem seen with the highest frequency was house-training mistakes, followed by over activity and wanting too much attention. Fear of

thunder was among the least common behavioral problems in relinquished dogs, accounting for only 16.5%. Interestingly, a fear of other loud noises was more common than a fear of thunder.

Of the 127 respondents that indicated their dog had a behavior problem, 103 (98.1%) said they identified the behavioral problem themselves. Less than a quarter (n = 26, 20.5%; n = 24, 18.9%) of the respondents indicated either a friend or relative identified the dog as having a behavior problem, respectively. Only 9.5% (n = 10) said a veterinarian aided in the behavioral diagnosis, whereas 27.6% (n = 35) of respondents sought a veterinarian's assistance in treating the problem. Thirty percent (n = 38) tried to treat their dog's behavior problem(s), with most using obedience training (n = 19, 15%). Other treatment options, including behavioral modification, prescriptions, and herbal remedies, were tried by 3.9% (n = 5), 5.5% (n = 7), and 1.6% (n = 2), respectively.

Table 3.2 Frequency of behavioral problems relating to canine relinquishment

Behavior Problem	n	% ^a
House-training mistakes	48	37.8
Overactive	42	33.1
Wants too much attention	41	32.3
Destructiveness indoors	36	28.3
Digging	36	28.3
Separation Anxiety	31	24.4
Escaping	30	23.6
Aggression towards animals	29	22.8
Aggression towards people	29	22.8
Disobedient	29	22.8
Fear of people/strangers	27	21.3
Barking	23	18.1
Fear of other loud noises	23	18.1
Not getting along with other pets	22	17.3
Destructiveness outdoors	21	16.5
Fear of thunder	21	16.5
Obsessive-compulsive disorder	19	15.0

^a Calculated based upon 127 respondents indicating at least one behavioral problem

Signalment

Of the 177 respondents indicating the pedigree of their dog(s), 80 (45.2%) were listed as purebred, while 97 (54.8%) were listed as a mixed breed. Of the mixed breed dogs, nearly 60% (n = 57) were of known breed origin. Purebred and known mixed breed dogs were classified

according to breed group (American Kennel Club, 2008). Table 3.3 presents the frequencies and percentages of dogs in each breed group. Dog breeds within the sporting group were the most common breeds relinquished.

Table 3.3 Frequency of relinquished dogs by breed group

Breed Group	n	% ^a
Sporting	39	28.5
Toy	24	17.5
Herding	22	16.1
Terrier	20	14.6
Working	17	12.4
Hound	8	5.8
Non-Sporting	7	5.11

^a Calculated based upon 137 respondents indicating a purebred or mixed breed dog of known breed origin

One hundred sixty-nine respondents indicated the sex of their dog(s) being relinquished. Ninety dogs (53.2%) were male; 79 (46.8%) were female. Slightly more respondents (n = 177) indicated whether or not their dog(s) was neutered or spayed. It was more common for dogs to be intact (n = 94, 53.1%) versus neutered (n = 83, 46.9%). Table 3.4 depicts the sex and neuter status of the dogs relinquished during this study. The average age of neutering was between six months and one year of age (Table 3.5). The average age at the time of relinquishment was between one and three years of age (Table 3.6).

Table 3.4 Frequency of relinquished dogs by sex

Sex	n	% ^a
M/I	49	29.0
M/N	41	24.3
F/I	40	23.7
F/S	39	23.1

^a Calculated based upon 169 respondents indicating both sex and neuter status
M = male, F = female, I = intact, N = neutered, S = spayed

Table 3.5 Frequency of relinquished dogs by age at neutering

Age	n	% ^a
< 6 months	21	26.3
6 months – 1 year	34	42.5
1-3 years	22	27.5
3-5 years	2	2.5
5-7 years	0	0
> 7 years	1	1.3

^aCalculated based upon 80 respondents indicating age at neutering

Table 3.6 Frequency of relinquished dogs by age at relinquishment

Age	n	% ^a
1-6 months	15	8.8
6 months - 1 year	30	17.7
1-3 years	59	34.7
3-5 years	23	13.5
5-7 years	17	10.0
7-9 years	7	4.1
9-11 years	5	2.9
11-13 years	5	2.9
13-15 years	6	3.5
> 15 years	3	1.8

^a Calculated based upon 170 respondents indicating age at time of relinquishment

Acquisition Factors

Acquisition factors were those factors contributing to the acquisition of the dog and included the source of the dog, the cost to purchase the dog, the age at acquisition, and the reason for obtaining the dog. Ten different options were offered as possible sources for obtaining dogs. Table 3.7 presents the frequencies and percentages pertaining to these options. More dogs were obtained from animal shelters/humane societies and private owners than any other source. The most common source listed as ‘other’ was from listings in the newspaper (n = 3). A variety of costs to purchase dogs were indicated by respondents. The majority of dogs were free, followed by those costing between \$51 and \$100. Table 3.8 presents data regarding the costs of purchasing dogs. Puppies and young dogs between one month and one year of age represented the most common age at acquisition (Table 3.9).

Table 3.7 Frequency of relinquished dogs by source of acquisition

Source	n	% ^a
Animal shelter/Humane society	40	22.9
Private owner (non-breeder)	40	22.9
Found stray	29	16.6
Breeder	25	14.3
Pet store	15	8.6
Gift	12	6.9
Other	6	3.4
Breed rescue organization	4	2.3
Dog's own litter	3	1.7
Veterinarian	1	0.6

^a Calculated based upon 175 respondents indicating the source of their dog

Table 3.8 Frequency of relinquished dogs by cost at acquisition

Cost	n	% ^a
Free	79	46.2
\$1-\$50	14	8.2
\$51-\$100	41	24.0
> \$100	37	21.6

^a Calculated based upon 171 respondents indicating the cost to purchase their dog

Table 3.9 Frequency of relinquished dogs by age at acquisition

Age	n	% ^a
1-6 months	98	59.4
6 months - 1 year	42	25.5
1-3 years	20	12.1
3-5 years	4	2.4
5-7 years	1	0.6

^a Calculated based upon 165 respondents indicating the age at acquisition

Five reasons for initially obtaining the dogs were given as possible options. Table 3.10 presents data regarding these different reasons. Companionship was the most common reason for having the dog as a pet. The next most common reason was for protection. Examples of 'other' reasons included compassion (n = 4), gifts (n = 3), and therapy dog (n = 1).

Table 3.10 Frequency of reasons for acquisition

Reason	n	% ^a
Companionship	153	91.1
Protection	29	17.3
Breeding	14	8.3
Other	12	7.1
Show	1	0.6

^a Calculated based upon 168 respondents indicating at least one reason for acquisition of their dog

Post-Acquisition Factors

Post-acquisition factors were those regarding the care the dog received following acquisition as well as the presence of other pets in the household at the time of relinquishment. Of 169 respondents, only 33 (19.5%) indicated their dog(s) had received any kind of obedience training. One hundred twelve respondents (65.9%, based on 170 total respondents) indicated their dog(s) had received veterinary care during the past year of ownership. At the time of relinquishment, it was less common (n = 57, 33.3%, based on 171 total respondents) for households to have any remaining pets at home.

Discussion

This study sought to determine the prevalence of canine relinquishment related to thunderstorm phobia. While the frequency of dogs relinquished with a fear of thunder was among the lowest of the behavioral problems, there were sufficient animals presented to indicate a real problem. Twenty-one dogs (16.5%) with a fear of thunder were relinquished to the participating animal shelters, clearly indicating that the presence of thunderstorm phobia can result in affected dogs being relinquished. While not clearly assessed in this study, it is possible that clinical signs related to a fear of thunder resulted in a diminished human-animal bond and ultimately relinquishment. Further studies are needed to further differentiate the specific factors that contribute to a dog being relinquished related to thunderstorm phobia.

In order to reduce the number of dogs relinquished relating to thunderstorm phobia, research is also needed to develop better treatment options. Veterinarians need to be educated as to the magnitude of this problem.

The information gained from this study is important because it indicates the consequences of this behavioral problem on the relationship between owners and their dogs. Proactive implementation of behavioral counseling by veterinarians is necessary to manage the problem before it becomes established and leads to relinquishment. Patronek et al. (1996) found a lack of veterinary care to be a risk factor for relinquishment, especially when associated with behavioral problems. The current study found 66% of respondents received veterinary care within the year preceding relinquishment; however, only 37% sought assistance from a veterinarian in diagnosing or managing undesirable behaviors. This difference could be associated with results found by Patronek and Dodman (1999), where, in a study of exclusively small animal veterinarians, it was found that only a small number routinely discussed behavior during examinations, let alone felt it was their responsibility to initiate the discussion. Understanding more about canine thunderstorm phobia, including the prevalence of related relinquishments, is important for veterinarians to feel comfortable with providing behavioral counseling.

As thunderstorm phobia is a treatable behavioral disorder, it was unfortunate that any affected dogs were relinquished to shelters. The most commonly employed methods of treatment are behavioral modification and pharmacotherapy, which can be difficult to implement, have variable success, and have minimal research to support their use. Because thunderstorm phobia is a complex condition, involving numerous fear-eliciting stimuli (e.g. thunder, barometric pressure) and the random occurrence of thunderstorm events, it can be difficult to implement a behavioral modification program successfully (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). Pharmacotherapy may be a helpful adjunct, especially when behavior modification is not successful (Shull-Selcer and Stagg, 1991), but very little research has been conducted specifically to assess medications for thunderstorm phobia. One such study, conducted by Crowell-Davis et al. (2003), found a combination of clomipramine, alprazolam, and behavior modification to be useful in treating thunderstorm phobia. Unfortunately, no other reported studies have assessed medications for the specific treatment of thunderstorm phobia. Consequently, research assessing current medications and leading to the development of new treatment options is necessary to help reduce the number of affected dogs relinquished to shelters.

While similar studies within the United States have assessed canine relinquishment related to fearfulness (Miller et al., 1996; Salman et al., 2000; Salman et al., 1998), no reported study has determined the prevalence of canine relinquishment related to thunderstorm phobia. However, the prevalence for thunderstorm phobic relinquishments from this study is anticipated to be comparable to other areas of the country where thunderstorms are experienced. Spring and summer months are the most common times of the year to experience thunderstorms, regardless of geographic location (Changnon, 2003). The central United States, where this study took place, have the second highest rate of thunderstorm activity, preceded by Florida and the Gulf Coast region, and followed by the southwest (Changnon, 2003).

Several other related factors were assessed in this study. Because of differences in study design, it is difficult to make direct comparisons with other studies having looked at reasons for relinquishments and characteristics of relinquished dogs. However, some similarities and differences were noted.

Similar to other studies (Miller et al., 1996; Mondelli et al., 2004; Salman et al., 1998; Shore, 2005), the current study found behavioral problems to be a leading cause of canine relinquishments. As veterinarians and animal shelter staff often serve as sources of professional animal care advice, it is important they provide information about normal dog behavior to clients. In addition, veterinarians should provide behavioral counseling during routine examinations to prevent the relinquishment of dogs to shelters for behavioral reasons.

Two of the most common behavioral problems related to relinquishment in the current study were house-training mistakes and overactive dogs. Similar findings were seen in other studies (Line, 1998; Miller et al., 1996; Patronek et al., 1996; Shore, 2005; Weng et al., 2006). Wanting too much attention from the owner was another very common behavioral problem related to relinquishment in the current study. It is possible that owners perceived over activity and wanting too much attention as being similar in nature, accounting for the similar number of dogs in each category.

Inappropriate elimination can have numerous causes including organic disease, poor housetraining, or anxiety/arousal-related elimination (Tynes, 2007). Incomplete housetraining or a lack of housetraining can be a result of a lack of education occurring early on in the puppy's life. As a part of routine puppy examinations, veterinarians should provide information about how to successfully house train dogs. Animal shelters adopting out puppies should also provide

resources on proper house-training. Having this information may help owners overcome the problem of house soiling resulting from poor housetraining and reduce relinquishments for this reason.

Being hyperactive or desiring attention from an owner may not necessarily indicate a behavior disorder, but instead behaviors that are perceived as problematic by the owner. The activity level of dogs can vary depending on age and breed, with young dogs, those bred for sporting and herding, and small breeds displaying higher activity tendencies. Seventy-seven percent of relinquished dogs were of a sporting, toy, herding, or terrier breed (regional and national dog ownership statistics were unavailable for comparison). Many of the breeds classified as sporting are those used for hunting. The high proportion of sporting, toy, herding, and terrier breeds relinquished may correlate with the high proportion of dogs relinquished relating to hyperactivity as hunting, herding, and smaller breeds tend to have higher activity levels (Hart and Hart, 1988, 37). Hyperactivity in dogs may also result from a lack of sufficient exercise. Educating owners of dogs about normal dog behavior, including activity level and exercise requirements, may help reduce the number of relinquishments for this reason.

Barking was determined to be a risk factor for unsuccessful ownership of dogs in Taiwan (Weng et al., 2006). However, excessive barking by dogs was among the less common behaviors associated with relinquishment in the current study. This difference may be related to cultural differences in tolerating this behavior between the United States and Taiwan.

Behaviors related to destructivity were exhibited in differing numbers of dogs. Digging, a behavior that can result in destruction, was exhibited in 28% of relinquished dogs. A similar number of dogs exhibited destructive behaviors indoors. Destructiveness outdoors, however, was only exhibited in 17% of relinquished dogs. Without having specified the location of digging within the survey, digging could refer to the behavior being performed either indoors or outdoors. However, it is possible that digging, which is commonly seen in relation to gardens or yards, may account for the majority of destructive behaviors seen outdoors, and any other behaviors associated with outdoor destructivity were exhibited less by relinquished dogs, accounting for the lower number.

Most of the behavior problems listed within the survey were written with layman wording. Two behaviors, though, were listed with scientific nomenclature: separation anxiety and obsessive/compulsive disorder (OCD). Relinquished dogs having separation anxiety were

higher in number (24%) compared to those said to exhibit OCD-related behaviors (15%). The difference between these results could be related to owners' understanding of the two disorders, with owners having a greater understanding of behaviors associated with separation anxiety.

Differences noted from previous research related to the relinquished dogs' pedigree and neuter status. Other studies have found a mixed breed pedigree and being sexually intact to be predisposing factors for relinquishment (Patronek et al., 1996; Salman et al., 1998; Shore, 2005). Nearly equal distributions of purebred and mixed breed dogs as well as sexually intact and neutered dogs were surrendered indicating these factors may have little, if any, effect on relinquishment in the current study.

Similarities relating to sex and age at relinquishment were noted between previous research and the current study. Several studies found no difference between the sex of relinquished dogs (Patronek et al., 1996; Salman et al., 1998; Shore, 2005). The current results were consistent with nearly equal distributions of each sex, indicating this is not a contributing factor for relinquishment. Patronek et al. (1996) determined that a dog less than six months of age was at greater risk for relinquishment. The current study found not only young puppies to be surrendered, but also those up to three years of age. This was a common age range in other studies as well (Miller et al., 1996; Salman et al., 1998; Weng et al., 2006).

The current study found that the most common reason reported for relinquishment was an unwanted litter. Line (1998) found similar results with unwanted litters being the most common reason for surrendering puppies to shelters. This, coupled with the fact that more sexually intact animals were surrendered to shelters, indicates that efforts to increase sterilization of pets would be beneficial to help reduce the number of dogs relinquished to shelters.

Interestingly, owner relinquishments because of the cost associated with owning a pet were lower (6%) than owner relinquishments because of the time and effort involved in caring for a pet (25%). It is possible that owners have more realistic expectations regarding the cost of pet ownership, but less realistic expectations about the amount of time and work involved in pet care. In a study assessing the human and personal issues (HPI) that affect relinquishment, 94% of dog owners were aware of potential costs of pet care, although a lack of time was cited as the most common HPI reason for relinquishment (Scarlett et al., 1999).

Factors associated with the acquisition of a dog have been found to be risk factors for unsuccessful ownership resulting in relinquishment. For example, Patronek et al. (1996)

determined the cost and source to have an effect on the risk of relinquishment. An animal obtained from a shelter or purchased from a private owner or those obtained at no cost were more likely to be relinquished (Patronek et al., 1996). The current study is consistent with these risk factors. The most common cost of a relinquished dog was free. The two most common sources of relinquished dogs were animal shelters and private owners. Similarly, Miller et al. (1996) found a greater number of dogs to be from private owners, whereas Salman et al. (1998, 2000) found dogs obtained from animal shelters to be at greater risk of relinquishment. As suggested by other authors (Patronek et al., 1996), it appears that the cost of obtaining a dog is a good indicator of the commitment and care provided to the animal post-acquisition, with those paying less having greater risk of relinquishing their pet. Since many dogs relinquished to shelters have come from shelters, it is important that animal shelter staff take a greater role in ensuring the success of adoptions by adequately assessing the temperament and behavioral problems of dogs up for adoption, by offering pre-adoption counseling to match potential adopters with appropriate pets, and by educating adopters about normal canine behavior.

The number of animals obtained from breed rescue organizations was relatively low (2.3%). Fewer dogs obtained from this source could relate to the higher adoption standards often utilized by breed rescue organizations. Owners taking dogs from this source back to breed rescues, instead of to animal shelters, may have also accounted for this difference.

Factors associated with the care of the dog after acquisition have also been determined as risk factors. Dogs are more likely to be relinquished if they receive minimal veterinary care (≤ 1 /year) or a lack of obedience training (Patronek et al., 1996). The current study found that only 20% of the respondents had received training for their dog, and 30% whose dogs had behavioral problems used training as a means of treatment. A greater number (66%) had taken their dog to a veterinarian within the year preceding relinquishment, possibly to fulfill legal requirements for vaccinations or spay/neuter. However, only a quarter of respondents indicating their dog had a behavioral problem sought care from a veterinarian for the behavioral problem. It is important for a dog's physical and behavioral health to see a veterinarian regularly. Since more respondents were seeking veterinary care (versus training) for their animals, it presents an opportunity for veterinarians to encourage their clients to enroll in obedience classes in order to promote well-mannered dogs and prevent relinquishment.

Several limitations of this study need to be addressed. First, low response rate in a survey-based study can cause nonresponse error (Dillman, 2000, 11). This study experienced a low rate of survey completion (14%); as a result, care should be taken to avoid generalizations beyond the sampled population of dogs. The rate had increased as compared to the pilot study, which had a response rate of 7.8%. It is possible that the extra precautions taken to ensure anonymity increased the number of owners feeling comfortable with completing the questionnaires. It is also possible that conducting the study over a one year period allowed for greater response to the surveys. Since the staff at the animal shelters still cited the fear of a breach of anonymity as the most common reason for refusing to take the survey, it is possible that despite the precautions taken, many potential respondents maintained a poor perception of anonymity, refusing to complete the survey for fear of their answers affecting their dog's adoptability. Another possible reason for the poor response rate can be attributed to each shelter's intake of owner-relinquished dogs. At least two of the participating shelters experienced a low intake because of lack of space. Their kennel space was occupied by dogs taken in as stray animals by animal control agencies. Unfortunately, this had an impact on the number of dogs that could be accepted from owners. This, in turn, resulted in fewer potential respondents for this study.

Second, since only eight shelters participated in this study, some sampling error occurred because not every dog owner relinquishing a dog to a Kansas shelter was surveyed. However, having a relatively large sample size from which to draw inferences about the survey population has minimized the amount of sampling error.

Third, since a general pet-owning population was not surveyed, there was no control group from which to compare information from this study. Instead, the data only describes the population of dogs surrendered to Kansas animal shelters during the course of this study.

Conclusion

Behavior problems in general were among the leading causes of canine relinquishment, with house-soiling and hyperactivity found to be the most frequently occurring. This was the first study to assess relinquishment related to thunderstorm phobia. Although the number of

surrendered dogs with a fear of thunder was relatively low, this data allows veterinarians and researchers to better understand the scope of this problem in relinquished dogs. Proactive behavioral intervention is necessary in managing behavioral problems effectively and preventing relinquishment.

Data from this study lends credibility to previous research as a similar age at relinquishment and no sex predisposition were found (Miller et al., 1996; Patronek et al., 1996; Salman et al., 1998; Shore, 2005; Weng et al., 2006). Source and cost at acquisition and a lack of obedience training were also consistent with other literature (Miller et al., 1996; Patronek et al., 1996; Salman et al., 2000; Salman et al., 1998).

CHAPTER 4 - Evaluation of DAP as a Potential Treatment for Canine Thunderstorm Phobia

Introduction

A research project was conducted to determine the efficacy of dog appeasing pheromone (DAP) in treating canine thunderstorm phobia. This chapter describes the importance of finding new and effective treatment options for this behavioral disorder. Background information about canine thunderstorm phobia, current treatments and their limitations, pheromone therapy, and the potential use of DAP as a treatment modality for affected dogs is reviewed. An overview containing the objective, hypotheses, research design, methods, and timeline are described for this project. Finally, the results of this DAP research project are presented and discussed.

Significance of Research

Behavior is the most common reason dogs are relinquished to animal shelters or euthanized (Houpt et al., 1996; Line, 1998; Miller et al., 1996; Mondelli et al., 2004; Salman et al., 2000; Salman et al., 1998; Shore, 2005; Wells and Hepper, 2000; Weng et al., 2006). Current research discovered 16.5% of relinquished dogs had a fear of thunder, clearly indicating that the presence of thunderstorm phobia can result in affected dogs being relinquished (see Chapter 2). The aim of this research was to determine the efficacy of DAP in treating canine thunderstorm phobia. Having another treatment option to offer owners of affected dogs will help decrease the likelihood that a dog will be surrendered to a shelter because of this disorder.

Existing treatment options, such as behavioral modification and pharmaceutical therapy, have several disadvantages and are not successful in every dog. However, the use of a pheromone as a potential treatment for thunderstorm phobia has many advantages.

Pheromone therapy is without side effects and toxicities that are typically associated with medications (Pageat and Gaultier, 2003). The mechanism of action of pheromones allows their use in older patients and those with medical conditions that may not be candidates for pharmaceuticals.

Background of Research

Thunderstorm phobia is a common and frustrating problem, with affected dogs often presented to veterinary behaviorists (McCobb et al., 2001; Voith and Borchelt, 1985b); for example, Shull-Selcer and Stagg (1991) determined that 87% of 30 phobic dogs at two university veterinary teaching hospitals were afraid of thunder. Additionally, current research found 52% of dogs to be thunderstorm phobic (see Chapter 2).

Canine thunderstorm phobia is a complex behavioral disorder that falls within a much larger category of phobic conditions to noises. Thunderstorm phobia, unlike other noise phobias (e.g., fear of fireworks or gunshots), does not merely have noise as a fear-eliciting stimulus, but may also involve other meteorological variables such as barometric pressure, sferics, and ozone level changes that can act as fear-eliciting stimuli (Overall, 2002; Voith and Borchelt, 1985b). Although thunder is thought to be the predominant stimulus causing fear in dogs, atmospheric changes associated with thunderstorm activity may either serve as a primary fear-eliciting stimulus or be associated with thunder via classical conditioning (Overall, 2002).

The neurophysiology of anxiety- and fear-based disorders is not well understood, but is thought to involve the limbic system with projections from the amygdala to the hypothalamus and locus coeruleus (Charney et al., 1998; Overall, 2002). Once stimulated, the hypothalamus and locus coeruleus activate the sympathetic branch of the autonomic nervous system and initiate a neuroendocrine response (Charney et al., 1998; Overall, 2002). As a result, the clinical signs associated with thunderstorm phobia are non-specific and range from dilated pupils and increased heart rate to panting, shaking, and hiding. More extreme clinical signs may include vocalizations, elimination, and destructive behavior. Living with dogs that cause damage to property and/or harm themselves can have a powerful and exasperating effect on the human-animal bond. The pet-owner relationship may be broken because of the unwanted behavior

exhibited by affected pets. The resulting break in the pet-owner bond leads to the relinquishment of these dogs to animal shelters.

Canine thunderstorm phobia is a treatable disorder (Overall, 2002; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985a). Treatment options include behavioral modification techniques and pharmaceutical therapy. However, they have had limited success and can be difficult to implement (Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). These disadvantages make them less than ideal in treating this condition.

Behavior modification for thunderstorm phobia consists of two processes, desensitization and counter-conditioning. Desensitization is a way of decreasing anxiety and fear with gradual exposure to weak and non-fearful stimuli (Voith and Borchelt, 1985b). Operant counter-conditioning works by conditioning behavioral responses from a dog that are incompatible with the undesired behavior (Voith and Borchelt, 1985a, b). Classical counter-conditioning involves conditioning emotional responses that are incompatible with an undesirable emotional state (Voith and Borchelt, 1985a). Desensitization and counter-conditioning used concurrently may lessen a dog's response to fearful stimuli by gradually exposing the dog to non-fearful stimuli and then rewarding behavioral and emotional responses other than those depicting anxiety or fear. However, this type of treatment may proceed too quickly, be interrupted by the presence of an actual storm, and is time consuming (Tuber et al., 1982; Voith and Borchelt, 1985b). The most frustrating problem with this type of treatment is that it is very challenging to reproduce all conditions of an actual storm, and therefore, is difficult to transfer the training to actual storm events (Shull-Selcer and Stagg, 1991; Tuber et al., 1982; Voith and Borchelt, 1985b).

Pharmacotherapy can be useful when the dog is not responsive to artificial storm conditions, making desensitization ineffective, or when exposure to real storms cannot be avoided (Shull-Selcer and Stagg, 1991). There is quite a wide range of pharmaceuticals available that can be used in the treatment of thunderstorm phobia, including antidepressants, anxiolytics, benzodiazepines, monoamine oxidase inhibitors, beta-blockers, phenothiazines, and anticonvulsants (Overall, 2002; Shull-Selcer and Stagg, 1991). With all that is available, it would seem simple to treat a thunderstorm phobic dog. However, individual dogs react differently to medications. Where a particular drug may work well in one dog, it may not work at all in another. It can be a challenging process to identify the drug (or combination thereof) that produces the desired and best results.

One clinical trial conducted specifically to assess pharmaceutical options for the treatment of canine thunderstorm phobia was done by Crowell-Davis et al. (2003) in which the effectiveness of a combination of clomipramine, alprazolam, and behavior modification was tested on 32 thunderstorm phobic dogs. Owners were asked to complete assessment questionnaires prior to and after treatment. Based on the comparison between the two assessments, all fear-related behaviors were significantly reduced and total assessment scores decreased 52% during the course of treatment. These results indicate this combination can be a useful treatment for thunderstorm phobia.

Other research relating to the treatment of thunderstorm phobia was conducted to assess the efficacy of an alternative therapy using the Storm Defender cape, which is thought to decrease a dog's sensitivity to static electricity (Cottam et al., 2005). Preliminary results found ten of 14 dogs experienced a moderate to great reduction in the intensity of clinical signs when wearing the cape, indicating its potential use in treating thunderstorm phobia.

Another study that may be applicable to the treatment of canine thunderstorm phobia was conducted by Seksel and Lindeman (2001) to determine the efficacy of a combination of clomipramine and behavioral modification in treating noise phobia, obsessive-compulsive disorder, and separation anxiety in dogs. Five of the 24 dogs in the study were diagnosed with noise phobia. Of these dogs, three experienced a large or moderate improvement in their behavior as a result of this study. The other two dogs' behaviors were unchanged by the treatment. This suggests that clomipramine combined with behavioral modification is an effective way to treat some noise phobias, but also alludes to the fact that not all dogs react similarly to medications which is a potential disadvantage when trying to treat affected dogs.

The findings of these studies indicate the need for further research to identify additional treatment options for thunderstorm phobia. Pheromotherapy is the use of pheromones to treat behavioral problems (Pageat and Gaultier, 2003). It is a potential treatment option for thunderstorm phobic dogs that warrants a study to evaluate its effectiveness.

Pheromones, used in a specialized form of chemical communication, are more than just simple odors (Pageat and Gaultier 2003). Pheromones are processed by a specialized organ, the vomeronasal organ (VNO), which is located on either side of the nasal septum (Pageat and Gaultier, 2003). The VNO must first be stimulated by emphasizing signals (typically a visual or olfactory stimulus from the animal releasing the pheromone) and subsequently opened to receive

the chemical messengers (Pageat and Gaultier, 2003). Pheromones are taken up by the VNO by flehmen behavior, which in the dog involves lip and nose licking and cheek puffing (Mills, 2005). From there, the pheromones are thought to act on both the limbic system and the hypothalamus (Pageat and Gaultier, 2003). Because pheromones only act on sensory receptors and are not internalized, they are able to initiate physiologic reactions without any adverse or toxic effects (Pageat and Gaultier, 2003).

Pheromones are secreted from a number of different glands. On the dog, there are pheromone-secreting glands located in the facial area (chin, lips, vibrissae, cheeks, and base of the ear) which are important in establishing and maintaining social relationships (Pageat and Gaultier, 2003). Two other pheromone-secreting areas on the dog that may be involved in social interactions include the perianal (supracaudal, circumanal, and anal glands) and genital (preputial, vulvar, and urethral glands) regions (Pageat and Gaultier, 2003). Pheromones are also secreted from the pedal region (plantar pads and interdigital skin) for territorial marking following elimination (Pageat and Gaultier, 2003). The fifth and most recently discovered area of pheromone secretion in mammals is from the mammary region (Pageat and Gaultier, 2003). In dogs, sebaceous glands located in the intermammary sulcus secrete 'appeasine' pheromones that serve to calm both juvenile and adult dogs; these specialized pheromones are secreted from within a few days post-parturition up to four months (Pageat and Gaultier, 2003). This particular pheromone, referred to as dog appeasing pheromone (DAP), has been synthetically reproduced and used to treat anxiety- and fear-evoking situations in dogs (Mills, 2005).

Several studies have evaluated the effectiveness of DAP in treating anxiety and fear producing situations in dogs. For example, Gaultier and Pageat (2003) tested acute exposure to DAP (delivered via spray) versus a placebo on travel anxiety in 32 dogs. There was a decrease in the car sickness behaviors for both groups, but more so in the DAP treatment group, indicating that DAP may be an effective means to reduce anxiety in dogs during travel.

Another study that assessed the efficacy of DAP on travel anxiety was conducted by Estellés and Mills (2006). DAP-impregnated collars were worn for six weeks by dogs enrolled in the study. Dogs were grouped according to behavioral signs exhibited during car rides. All groups of dogs showed significant improvement with DAP treatment, although the responses between groups were not consistent as dogs in the nausea group experienced greater improvement than did those in the tense or excitable groups.

Mills et al. (2006) conducted a two-part study on the effectiveness of acute exposure to DAP (delivered via diffuser) versus a placebo on fear elicited by veterinary clinics. The first part assessed dogs' behaviors while waiting for an examination, while the second part assessed the dogs' behaviors during the actual examination. Dogs in the DAP treatment group tended to be less anxious and more relaxed while in both the waiting and examination rooms as compared to the placebo group. This study suggests the benefit of using DAP in veterinary clinics to help alleviate and/or prevent anxious or fearful behaviors associated with clinics and examinations.

Gaultier et al. (2005) compared DAP (delivered via diffuser) to clomipramine as a treatment of separation anxiety in 57 dogs. Treatments were given for 28 days. The results of this study revealed that anxious behaviors were decreased with both treatments; however, owners were more pleased with the fewer side effects and ease of administration of the DAP as opposed to clomipramine.

The use of DAP (delivered via diffuser) to reduce fearful behaviors in dogs housed in shelters was tested by Tod et al. (2005). This study revealed that following seven days of exposure, barking amplitude and frequency were decreased, while resting and exploratory behaviors were increased in dogs exposed to DAP as compared to a placebo group. This suggests that DAP may be a useful tool in decreasing fear in shelter dogs.

Taylor and Mills (2007) assessed the efficacy of DAP (delivered via diffuser) on disturbance and house soiling behaviors of newly adopted puppies. Exposure to treatment occurred for eight weeks. For puppies that tended to vocally disturb their owners during the first few nights post-adoption, a significant reduction in disturbance behavior occurred with those exposed to DAP versus a placebo. This suggests that DAP may be effective in preventing nighttime vocalizations of recently adopted puppies.

Two studies have assessed the efficacy of DAP in treating a noise phobia. The first was conducted by Sheppard and Mills (2003) in which DAP was used to treat dogs fearful of fireworks. Diffusers provided DAP to enrolled dogs for at least two weeks prior to fireworks exposure. Twenty-two owners reported a decreased incidence of fearful behaviors at the conclusion of the study when compared to the initial baseline assessment. Nineteen of the 30 dogs studied also had a fear of thunder. Even though over half of the dogs in the fireworks study were fearful of thunder, this study did not assess DAP as a potential treatment to noises other

than fireworks. The authors suggest that because the fear of fireworks falls into a larger category of noise phobias, DAP should be effective in treating fears of other loud noises as well.

The second study also related to the fear of fireworks. In this particular study, Levine et al. (2007) combined the use of DAP with two self-administered CD-based behavior modification programs. When compared to baseline values, dogs exhibited significant improvement in 12 of 14 behaviors at two post-treatment assessments. This study further strengthens the evidence for DAP as a possible treatment for the fear of fireworks.

No research reported, to this date, has explored the effectiveness of DAP in treating canine thunderstorm phobia.

Current Study

This research project involved the administration of DAP and a placebo via an electrical plug-in diffuser to thunderstorm phobic dogs. The purpose of this research was to determine the efficacy of DAP as a sole treatment for the reduction or alleviation of fearful behaviors in thunderstorm phobic dogs.

Research Hypotheses

The hypotheses for this study were as follows:

Null hypothesis (H_0): DAP has no effect on dogs' fearful behavior during thunderstorm activity.

Alternative hypothesis 1 (H_{A1}): DAP reduces dogs' fearful behavior during thunderstorm activity.

Research Design

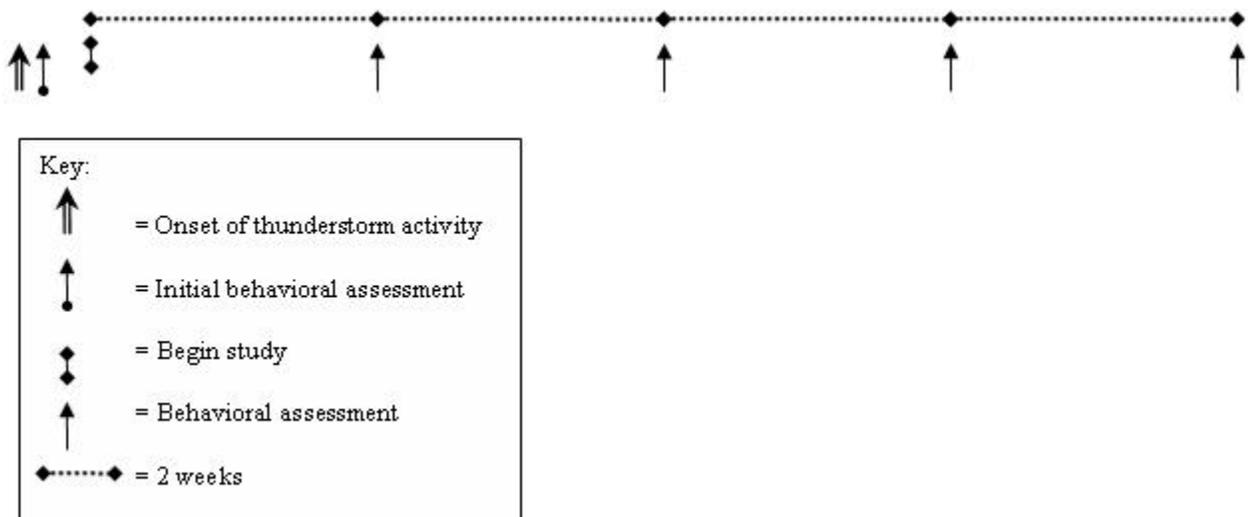
Project Overview

Data was collected in a prospective manner using a survey-based format to query pet owners prior to and throughout the study period regarding their dogs' fearful behaviors during thunderstorm activity. This was a double-blind, randomized, placebo-controlled study in which dogs were either administered DAP or a placebo as one of two treatment groups. The total study period was eight weeks, composed of four 2-week segments. After the initial questionnaire prior to treatment, four additional questionnaires were completed by owners every two weeks. Data analysis was completed after the end of the study period.

Project Timeline

As the potential lack of recall by owners from the previous thunderstorm season might have introduced bias, the study began after the onset of thunderstorm activity in the summer of 2007 to allow a more accurate assessment of each dog's fearful activity to thunderstorms during the initial pre-study behavioral assessment. The study ran for eight weeks (Figure 4.1) to account for variability in thunderstorm activity that occurred during the thunderstorm season.

Figure 4.1 Project timeline



Recruitment of Dogs

Dogs were recruited for this study by sending letters and posters (Appendix D) advertising the study to regional veterinary clinics, pet stores, dog boutiques, dog boarding facilities, dog parks, kennel clubs, and obedience trainers. Additionally, an advertisement (Appendix D) was placed in a local newspaper on three separate occasions. A university press release was distributed to numerous regional media sources. The study was advertised in areas where owners of thunderstorm phobic dogs were likely to see the information.

Owners interested in enrolling their dog(s) in this study contacted the researcher to set up an initial interview which took place over the telephone. The researcher thoroughly discussed the dog's behavioral and medical history (including current medications and indications) with the owner to confirm a diagnosis of thunderstorm phobia, and that the dog was in good health. If the dog met the inclusion criteria, the owner was invited to make an appointment with the researcher for a physical examination of his or her dog(s). The researcher used the medical history (Appendix E) and physical examination (Appendix F) as a subjective measure of health status. No medical work-up involving invasive procedures for blood or other analytes was performed.

In order to be included in this study, dogs needed to exhibit a consistent fearful response to at least three thunderstorms (as per the selection criteria used by Crowell-Davis et al. (2003)) as well as meet the necessary and sufficient diagnostic criteria for thunderstorm phobia as set forth by Overall (1997, 519): "Sudden and profound, nongraded, extreme response to any aspect of thunderstorms (noise, dark, changes in barometric pressure, changes in ozone levels) manifest as intense, active avoidance, escape, or anxiety behaviors associated with the activities of the sympathetic branch of the autonomic nervous system; behaviors can include catatonia or mania concomitant with decreased sensitivity to pain or social stimuli; repeated exposure results in an invariant pattern of response." In addition, the dogs needed to spend at least 70% of their time indoors in order to be exposed sufficiently to the treatments administered via the electrical diffuser.

Dogs were excluded from this study if they met any of the following criteria: not fearful of thunderstorms; concurrent behavioral disorders (e.g., cognitive dysfunction syndrome, separation anxiety); concurrent medical diseases (if uncontrolled or untreated); or recently or currently on any psychotropic medications or herbal remedies. Dogs having received prior

psychotropic medications or herbal remedies were asked to discontinue its use prior to and during the duration of the study.

Treatment Methods

This study used a double-blind, randomized, placebo-controlled design. Dogs that met the inclusion criteria for the study were randomly assigned to one of two groups using a random number generator for pairs. The experimental group was treated with DAP (Ceva Santé Animale, Libourne Cedex, France), whereas the control group received the placebo. The DAP and placebo (delivery vehicle only) were distributed via an electrical plug-in diffuser. A vial containing the pheromone or placebo was screwed onto the diffuser, and the diffuser was plugged into a 110 volt electrical outlet (VPL, 2004). The diffuser volatilized the pheromones into the air by mildly heating a wick within the vial. One set of diffusers was labeled A, and the other set was labeled B. Only the company supplying the diffusers knew which diffusers contained DAP and which did not. Diffusers and contents were identical in all physical appearances except for the letters A or B. The researcher did not know prior to or during the study which group was experimental and which was the control. The identity of A and B was not revealed to the researcher or participants until completion of the statistical analysis.

A diffuser and two 48ml vials of DAP with vehicle (T₁) or vehicle only (T₂) were distributed to owners with instructions (Appendix G) on how to assemble the diffuser and where to place it (i.e., in the room most used by the dog, in an open area, and not behind furniture). The owners were given instructions (Appendix G) on how to handle their pet's fearful behaviors during the study (i.e., no reinforcement, no punishment). This was done in an attempt to minimize the effects of learning that may affect the fearful behaviors of dogs. One vial lasted approximately four weeks with a coverage area of 500 to 650 square feet (VPL, 2004). Owners were instructed to change the diffuser halfway through the study. The study period lasted eight weeks.

Survey Design

The survey instruments used in this project were developed using the principles of survey development for behavioral science research (Dillman, 2000) and were adapted from similar

questionnaires used by Sheppard and Mills (2003) and Crowell-Davis et al. (2003). The survey questions were written in a closed-ended manner allowing for discrete data to be collected.

Nineteen behaviors were chosen for assessment based on typical clinical signs exhibited by thunderstorm phobic dogs. Owners of dogs enrolled in the study were asked to rate each behavior on both frequency and intensity scales. The frequency scale sought to determine how often a particular behavior was performed, whereas the intensity scale determined the severity of each behavior. The questionnaire was designed such that if a behavior was never performed by the dog, and consequently never observed by the owner, the resulting frequency level was 'never.' In this case, the owner would skip the intensity scale for this behavior and proceed to the next behavior on the questionnaire. If a frequency other than never was recorded, meaning the dog displayed the behavior, the owner was also asked to indicate its intensity.

Owner Assessment of Fearful Behavior

Owners of dogs enrolled in the study were asked to complete an initial questionnaire (Appendix H) assessing their dog's fearful behaviors during thunderstorm activity to provide a baseline level prior to initiation of any treatment. Owners were asked to keep a diary (Appendix I) of the thunderstorm events that occurred during the eight week study period in addition to completing questionnaires (Appendix J) every two weeks to assess their dog's fearful behaviors during thunderstorm activity. At the end of the study, the owners were asked to complete a final questionnaire (Appendix K) assessing their dog's fearful behaviors during thunderstorm activity.

Dog owners are intimately familiar with their own dogs' behaviors. They are also acutely aware of the fearful situations (i.e. thunderstorm activity) that evoke them. As a result, owners are typically accurate when observing and assessing fearful reactions of their dogs (McCobb et al., 2001; Voith and Borchelt, 1985b). Therefore, the researcher was confident that owner-based assessments would produce valid results.

Statistical Analysis

Data collected from the behavioral assessment questionnaires and the thunderstorm event diaries were entered into a spreadsheet. Owners recorded frequency ratings as either never, rarely, sometimes, often, or always. Intensity levels were recorded as mild, moderate, or severe.

Overall scores were assigned for each possible pairing of frequency and intensity. These scores were based on relative differences between each frequency/intensity pairing (see Tables 4.1 and 4.2). As both frequency and intensity increased, the overall score increased. A frequency of never was given a score of zero. This type of scoring system allowed for the degree of behavioral change throughout the study to be assessed with greater accuracy. The overall assessment scores were analyzed using the SAS statistical software package (SAS Institute Inc., Cary, NC, USA).

In order to be included in the statistical analysis, dogs had to have at least three post-treatment questionnaires completed for comparison to the pre-treatment questionnaire. Additionally, comparisons were assessed only for behaviors which dogs exhibited pre-treatment. These two criteria allowed for a more conservative analysis of the data.

Statistical analyses were performed with the Mixed Procedure of SAS. A repeated measures analysis was conducted to account for the effects of treatments and observational periods. The Satterthwaite adjustment was used for the degrees of freedom. All treatment means were separated ($p < 0.05$) using the LSD procedure when the respective F-tests were significant ($p < 0.05$). The Wilcoxon rank sums test was used to compare age, severity of clinical signs, and thunderstorm exposure between the two treatment groups. The chi-square test was used to test the association between treatment groups and sex, neuter status, pedigree, and concurrent medical conditions.

Following completion of this analysis, the identities of the two treatment groups were revealed to the researcher. Treatment A was identified as the pheromone, and treatment B was identified as the placebo.

Table 4.1 Matrix depicting overall scores for frequency/intensity pairings

	Mild	Moderate	Severe
Rarely	1	2	3
Sometimes	2	3	4
Often	3	4	5
Always	4	5	6

Table 4.2 Overall scores for frequency/intensity pairings

Pairing	Score
Rarely/Mild	1
Rarely/Moderate	2
Sometimes/Mild	2
Rarely/Severe	3
Sometimes/Moderate	3
Often/Mild	3
Sometimes/Severe	4
Often/Moderate	4
Always/Mild	4
Often/Severe	5
Always/Moderate	5
Always/Severe	6

Human and Animal Subjects Protection

The research project was conducted with approval from both Kansas State University's Institutional Animal Care and Use Committee and Institutional Review Board prior to the initiation of this study. Owners of dogs enrolled in the study were asked to complete several behavioral assessment questionnaires, whereas dogs were exposed to one of the two treatments. Owners of dogs enrolled in the study were informed of any potential risks associated with this study (including the amount of time involved for completing questionnaires and diaries) and asked to sign a consent form (Appendix L) prior to their inclusion in the study. All dogs remained in the care of their owners throughout the study.

Results

Population Characteristics

Sixty dogs of various ages, breeds, and gender status were originally enrolled in this study (Table 4.3). Forty-two dogs were pure breeds, and 18 were mixed breeds. The breeds represented included Border Collies (5), Labrador Retrievers (5), Golden Retrievers (4), Yorkshire Terriers (4), Miniature Poodles (3), Shih Tzus (3), Beagles (2), Corgis (2), and one each of the following breeds: Australian Shepherd, Boston Terrier, English Setter, Greyhound,

Lhasa Apso, Nova Scotia Duck Tolling Retriever, Parsons Russell Terrier, Pekingese, Pug, Smooth Fox Terrier, Springer Spaniel, Tibetan Terrier, Weimaraner, and West Highland White Terrier.

Dogs were randomly assigned within each block of two treatments based upon sequence of enrollment of animals in the study. Using sequence of enrollment as a blocking criterion allowed greater probability that both animals within a block would experience similar thunderstorm events within a similar timeframe. There were no differences between the two treatment groups regarding sex ($X^2 = 0.8000$, d.f. = 1, $p > 0.05$), neuter status ($X^2 = 1.0714$, d.f. = 1, $p > 0.05$), age (Wilcoxon, $p > 0.05$), or pedigree (i.e. pure breed versus mixed breed) ($X^2 = 3.3277$, d.f. = 2, $p > 0.05$). There was no difference between the two treatment groups with respect to the severity of clinical signs that the dogs exhibited during thunderstorms as assessed by owners during the behavioral history (Wilcoxon, $p > 0.05$). There was no difference between the two treatment groups regarding the presence of well-controlled, concurrent medical conditions ($X^2 = 0.2778$, d.f. = 1, $p > 0.05$). There was no difference between the two treatment groups regarding the number of thunderstorm events to which dogs were exposed during the eight week treatment period (Wilcoxon, $p > 0.05$).

Table 4.3 Population characteristics by treatment group

	Overall	Treatment A	Treatment B
Age range ^a (mean, median)	2 – 15 (7.29, 7)	3.5 – 15 (7.28, 6.5)	2 – 13 (7.3, 7.5)
Sex			
M/I	1	0	1
M/N	14	6	8
F/I	3	1	2
F/S	42	23	19
Pedigree status			
Pure breed	42	24	18
Mixed breed	18	6	12
n	60	30	30

^a Measured in years

M = male; F = female; I = intact; N = neutered S = spayed; n = sample size

Survey Response

Questionnaires were supposed to be completed for any thunderstorm event(s) that occurred within each of four consecutive two-week periods following enrollment. Fifty-six participating owners completed the baseline (pre-treatment) questionnaire. Fifty-three participants completed the first two-week post-treatment questionnaire. Fifty-two completed the second post-treatment questionnaire. Forty-eight completed the third post-treatment questionnaire. Forty-two completed the fourth post-treatment questionnaire. The differences in these numbers by observation period can be attributed to differences in thunderstorm exposure. As the study progressed, there were fewer thunderstorms that affected the general study area. Some dogs were not exposed to any thunderstorms during one or more of the two-week reporting periods, resulting in the questionnaire for that period being left blank.

Depending on where the individual dogs were physically located, the number of thunderstorm events experienced during the first two week period of the study varied from one to eight. Similar numbers of thunderstorm events were recorded for the remaining three two-week periods, with one to seven, one to eight, and one to six storms, respectively.

Of the sixty dogs enrolled in the study, the results from ten participants were not included in the final analysis. Two participants completed the study but lost their paperwork. One participant abruptly discontinued the study because the electrical diffuser smelled hot, and the participant feared creating a safety hazard. Another participant did not complete the study because the dog did not show signs of thunderstorm phobia after being enrolled but before being started on treatment, despite a phobic response being observed to at least three storms prior to enrollment in the study. Six participants were excluded from analysis because they only completed one or two post-treatment questionnaires. Thus, fifty participants (24 in treatment A, 26 in treatment B) provided information that could be used for analysis in the study.

Clinical Scores

When pre-treatment behavioral assessments were compared, the initial scores for each behavior across the two treatment groups were not significantly different (Table 4.4, $p > 0.05$, A1:B1).

After the treatments were administered, several behaviors were significantly improved in dogs given the placebo (Table 4.5, $p < 0.05$, A1:A2-5, B1:B2-5; Figure 4.2). The behaviors that significantly improved with treatment B were related to panting, excessive salivation, cowering, uncontrollable elimination, owner solicitation, and remaining near the owner. Several behaviors also showed significant improvement on treatment A, including panting, cowering, and remaining near the owner; however, the significance was to a lesser degree than that associated with the placebo.

Behaviors that showed a numerical trend toward improvement with both treatments, but were not statistically significant overall, were related to increased alertness, shaking/trembling, vocalization (excluding howling), and attempting to escape. Other behaviors that showed a numerical trend toward improvement on treatment B, but were not statistically significant overall, were related to yawning, aggression, increased and decreased activity, property destruction, and hiding. Self-injurious behavior, and howling were not affected by either treatment.

Table 4.4 Comparison of individual enrollee behaviors prior to initiation of treatments

Behavior	A1:B1 (Pr > t)
Yawning	0.4497
Panting	0.8451
Excessive salivation	0.6315
Increased alertness	0.8469
Shaking/Trembling	0.9380
Cowering	0.7274
Whimpering/Whining	0.4764
Howling	0.2302
Barking	0.2946
Aggression	0.0985
Uncontrollable elimination	0.4795
Increased activity	0.4212
Decreased activity	0.7493
Owner solicitation	0.0777
Remaining near owner	0.4689
Escape attempts	0.6213
Property destruction	0.8082
Self-Injury	1.0000
Hiding	0.2544

A1 = Pre-treatment assessment for dogs enrolled in treatment A

B1 = Pre-treatment assessment for dogs enrolled in treatment B

Table 4.5 Comparison of individual behaviors by treatment group by observation period

Behavior	Overall	A1:A2 (Pr > t)	A1:A3 (Pr > t)	A1:A4 (Pr > t)	A1:A5 (Pr > t)	B1:B2 (Pr > t)	B1:B3 (Pr > t)	B1:B4 (Pr > t)	B1:B5 (Pr > t)
	Effect (Pr > F)								
Yawning	0.6165	0.0905	0.1551	0.6989	0.9721	0.1847	0.0378	0.0832	0.1218
Panting	0.0411*	0.0079*	0.0048**	0.0005**	0.0005**	0.0003**	<0.0001†	<0.0001†	<0.0001†
Excessive salivation	0.0179*	0.5636	0.6158	0.6883	0.5760	0.0008**	<0.0001†	<0.0001†	0.0005**
Increased alertness	0.1758	0.0664	0.0282	0.0024	0.0005	0.0001	<0.0001	<0.0001	<0.0001
Shaking/ Trembling	0.0709	0.0200	0.0202	0.0174	0.0118	<0.0001	<0.0001	<0.0001	<0.0001
Cowering	0.0301*	0.2085	0.0028**	0.0026**	0.0509	0.0002**	<0.0001†	<0.0001†	<0.0001†
Whimpering/Whining	0.3578	0.7065	0.4001	0.0081	0.2684	0.1539	0.0016	0.0057	0.0077
Howling	0.7356	1.0000	1.0000	1.0000	1.0000	0.1583	0.0821	0.1583	0.3992
Barking	0.8258	0.1368	0.1368	0.0843	0.0500	0.1042	0.0327	0.0087	0.0041
Aggression	0.1283	0.2652	0.2652	0.2652	0.5717	0.0107	0.0107	0.0107	0.0107
Uncontrollable elimination	0.0164*	0.2216	0.4730	0.5029	0.8474	0.0003**	0.0003**	0.0003**	0.0006**
Increased activity	0.0984	0.0577	0.3671	0.6219	0.3602	0.0062	<0.0001	0.1345	0.0040
Decreased activity	0.5171	0.1612	0.8131	0.8131	0.7482	0.1319	0.0260	0.1084	0.2492
Owner solicitation	0.0071*	0.2384	0.2275	0.1017	0.6346	<0.0001†	<0.0001†	<0.0001†	<0.0001†
Remaining near owner	0.0080*	0.2917	0.8426	0.0187*	0.1917	0.0005**	<0.0001†	<0.0001†	<0.0001†
Escape attempts	0.4948	0.1742	0.0589	0.0078	0.0079	0.0001	<0.0001	<0.0001	0.0002
Property destruction	0.4492	0.6515	1.0000	0.4450	0.2549	0.0171	0.0080	0.0030	0.0036
Self-Injury	0.4297	0.4071	1.0000	0.1492	0.1492	0.1492	0.1492	0.1211	1.0000
Hiding	0.3475	0.3121	0.4910	0.3214	0.4953	0.0203	0.0044	0.0066	0.0007

A1 = Pre-treatment assessment for dogs enrolled in treatment A

A2 = First post-treatment assessment for dogs enrolled in treatment A

A3 = Second post-treatment assessment for dogs enrolled in treatment A

A4 = Third post-treatment assessment for dogs enrolled in treatment A

A5 = Final post-treatment assessment for dogs enrolled in treatment A

B1 = Pre-treatment assessment for dogs enrolled in treatment B

B2 = First post-treatment assessment for dogs enrolled in treatment B

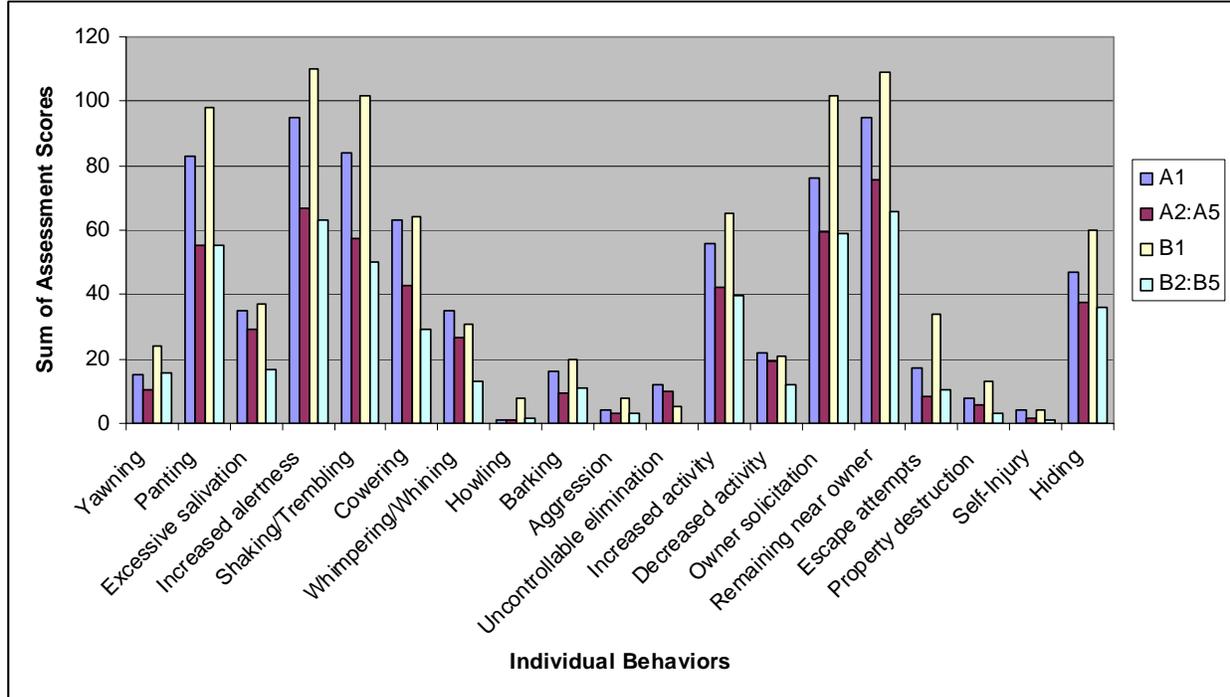
B3 = Second post-treatment assessment for dogs enrolled in treatment B

B4 = Third post-treatment assessment for dogs enrolled in treatment B

B5 = Final post-treatment assessment for dogs enrolled in treatment B

*P < 0.05, **P < 0.005, †P < 0.0001 (when overall effect is significant)

Figure 4.2 Comparison of individual behaviors by treatment groups by observation period



A1 = The sum of all assessment scores from the pre-treatment assessment for dogs enrolled in treatment A
 A2:A5 = The average of the sum of all assessment scores from the four post-treatment assessments for dogs enrolled in treatment A
 B1 = The sum of all assessment scores from the pre-treatment assessment for dogs enrolled in treatment B
 B2:B5 = The average of the sum of all assessment scores from the four post-treatment assessments for dogs enrolled in treatment B

Behaviors assessed during this study were grouped according to similarities (Table 4.6) and composite scores were calculated for the groups by simply adding the individual assessment scores for the behaviors within the group. When pre-treatment behavioral assessments were compared, the initial scores for each composite group across the two treatments were not significantly different (Table 4.7, $p > 0.05$, A1:B1).

Physiological, escape/shelter-seeking, and altered activity behaviors were significantly improved with treatment B (Table 4.8, $p < 0.05$, A1:A2-5, B1:B2-5). Scores for escape and shelter-seeking behaviors were analyzed both together and separately. Alone, shelter-seeking behaviors had greater statistical significance than did escape behaviors. Although there was significant improvement with treatment A for all of these behaviors, the statistical significance was to a lesser degree than that seen with the placebo. Additionally, vocalization behaviors showed a numerical trend toward improvement with both treatments, but were not statistically

significant overall. Destructive behaviors showed a numerical trend toward improvement with treatment B, but were not found to be statistically significant overall.

Table 4.6 Individual behaviors included within each composite group

Composite Group	Individual Behaviors
Physiological	Yawning, panting, excessive salivation, shaking/trembling, uncontrollable elimination
Escape/Shelter-seeking	Cowering, remaining near owner, owner solicitation, escape attempts, hiding
Destructive	Property destruction, self-injury
Vocalization	Whimpering/whining, howling, barking
Altered Activity	Increased alertness, aggression, increased or decreased activity
Escape	Cowering, escape attempts
Shelter-Seeking	Remaining near owner, owner solicitation, hiding

Table 4.7 Comparison of composite enrollee behaviors prior to initiation of treatments

Composite Group	A1:B1 (Pr > t)
Physiological	0.6949
Escape/Shelter-seeking	0.1656
Destructive	0.5649
Vocalization	0.8411
Altered Activity	0.6401
Escape	0.2562
Shelter-Seeking	0.1535

A1 = Pre-treatment assessment for dogs enrolled in treatment A

B1 = Pre-treatment assessment for dogs enrolled in treatment B

Table 4.8 Comparison of composite groups by treatment group by observation period

Composite Group	Overall	A1:A2	A1:A3	A1:A4	A1:A5	B1:B2	B1:B3	B1:B4	B1:B5
	Effect (Pr > F)	(Pr > t)							
Physiological	0.0193*	0.0043**	0.0043**	0.0041**	0.0046**	<0.0001†	<0.0001†	<0.0001†	<0.0001†
Escape/ Shelter-seeking	0.0022**	0.1139	0.0708	0.0038**	0.0710	<0.0001†	<0.0001†	<0.0001†	<0.0001†
Destructive	0.5753	0.4225	1.0000	0.1650	0.0978	0.0243	0.0147	0.0090	0.0226
Vocalization	0.5307	0.7050	0.2602	0.0198	0.1403	0.0442	0.0005	0.0013	0.0023
Altered Activity	0.0357*	0.0112*	0.0628	0.0738	0.0179*	<0.0001†	<0.0001†	<0.0001†	<0.0001†
Escape	0.0248*	0.1470	0.0029**	0.0008**	0.0104*	<0.0001†	<0.0001†	<0.0001†	<0.0001†
Shelter-Seeking	0.0063*	0.1962	0.4010	0.0095*	0.3017	<0.0001†	<0.0001†	<0.0001†	<0.0001†

A1 = Pre-treatment assessment for dogs enrolled in treatment A

A2 = First post-treatment assessment for dogs enrolled in treatment A

A3 = Second post-treatment assessment for dogs enrolled in treatment A

A4 = Third post-treatment assessment for dogs enrolled in treatment A

A5 = Final post-treatment assessment for dogs enrolled in treatment A

B1 = Pre-treatment assessment for dogs enrolled in treatment B

B2 = First post-treatment assessment for dogs enrolled in treatment B

B3 = Second post-treatment assessment for dogs enrolled in treatment B

B4 = Third post-treatment assessment for dogs enrolled in treatment B

B5 = Final post-treatment assessment for dogs enrolled in treatment B

*P < 0.05, **P < 0.005, †P < 0.0001 (when overall effect is significant)

Discussion

The identity of the two treatment groups was revealed to the researcher following the completion of the statistical analysis. Treatment A was revealed as the pheromone (DAP), whereas treatment B was the placebo. Consequently, dog appeasing pheromone does not appear to have an effect in reducing fearful behaviors associated with thunderstorm phobia when compared to negative controls. There was a significant reduction in the assessment scores of six of 19 behavioral signs exhibited by thunderstorm phobic dogs exposed to the placebo when compared to those receiving the pheromone. There was a numerical trend of improvement in eleven additional behaviors in the placebo group even though they did not reach the level of statistical significance. However, significant improvement in three behaviors versus baseline values was also seen in dogs given DAP. Additionally, five other behaviors showed a numerical trend of improvement in dogs given DAP even though they did not reach the level of statistical significance.

The behaviors that significantly improved from baseline values while exposed to placebo were related to panting, excessive salivation, cowering, uncontrollable elimination, owner solicitation, and remaining near the owner. Improvement was seen to a lesser degree in dogs exposed to DAP regarding panting, cowering, and remaining near the owner. Escape/shelter-seeking behaviors are likely adaptive behavioral responses to fearful stimuli, such as loud noises. Behaviors related to panting, salivation, and uncontrollable elimination are associated with a physiological fear response. Although DAP had an effect on both adaptive and physiological responses to fearful stimuli associated with thunderstorms, its effect was to a much lesser degree than that seen from the placebo.

For dogs exposed to the placebo, assessment scores were numerically lower but not statistically different for yawning, aggression, increased and decreased activity, property destruction, and hiding related behaviors. Assessment scores were numerically lower but not statistically different for increased alertness, shaking/trembling, vocalization (excluding howling), and escape attempts in dogs of both treatment groups. Therefore, one can conclude that either the pheromone did not have an effect on these behaviors or that there was inadequate

statistical power to detect differences between the two treatment groups. Both conclusions are plausible.

There was no evidence of improvement in either treatment group for two of the behaviors studied. This lack of statistical significance could in part be due to the small proportion of dogs that performed these behaviors in pre-treatment assessments. For example, howling was only exhibited by three dogs (6%) on the pre-treatment questionnaire. Only eight percent ($n = 4$) of dogs exhibited self-injurious behavior on the pre-treatment questionnaire. The behaviors causing self-injury could consist of redirected activity towards a part of the body as exhibited by excessive grooming. Other self-injurious behaviors could include those associated with increased activity or escape attempts that result in the dog becoming injured in some way. It is possible that owners accounted for these latter behaviors in other parts of the assessment questionnaire that asked specifically about the level of increased activity and attempting to escape, thereby reducing the sample size for this particular behavior.

The fear of fireworks and the fear of thunderstorms are both considered noise phobias, although the fearful stimuli involved in thunderstorm activity are more complex and may include meteorological variables in addition to noise (Overall, 2002; Voith and Borchelt, 1985b). Many dogs have concurrent fears of both fireworks and thunderstorms (Overall et al., 2001; Sheppard and Mills, 2003) (see Chapter 2). Eight-five percent of the dogs enrolled in the current study were also said to exhibit fearful behaviors in response to fireworks.

An open clinical trial, in which all dogs received DAP as the treatment, was conducted by Sheppard and Mills (2003) to evaluate DAP for treating fireworks fears in dogs. The results of their study indicated that nine of 14 behavioral parameters had significantly decreased in frequency during treatment with dog appeasing pheromone. The behaviors significantly improved with treatment were panting, trembling, salivating excessively, cowering, vocalization, hiding, increased activity, destructive behaviors, and restlessness. Although there was no placebo control, results from their study suggest DAP is useful in treating the fear of fireworks.

Without the use of a control group in the fireworks fear study, it is possible that owner actions had a confounding effect on the dogs' behaviors thereby influencing the results of the study. As owners are often frustrated and distressed with their dogs' behaviors, it is possible that a change in the owners' emotional states after being given a treatment for their dogs may impact the emotional states of the dogs via classical counter-conditioning.

While the current study found some significant improvement in thunderstorm phobia caused by the administration of dog appeasing pheromone, it was to a much lesser degree than that seen within the placebo group. It is possible that the differences in the fearful stimuli between fireworks and thunderstorms contributed to this difference in results between these two studies. In addition, fireworks displays tend to be more discrete events, whereas thunderstorm activity is random and includes meteorological changes before and after the storm event. From an evolutionary standpoint, there may be a greater importance in fear responses towards thunderstorm activity versus fireworks. As a result, the fearful emotional state in thunderstorm phobic dogs may be less amenable to treatment with an alternative therapy, such as dog appeasing pheromone.

Pheromones are able to initiate physiologic reactions without any adverse effects or reactions with other medications because of their mechanism of action (Pageat and Gaultier, 2003). Accordingly, dogs with concurrent medical diseases were allowed to participate in the study, provided the medical conditions were well-controlled and void of any clinical signs similar to those evoked by thunderstorm activity. By allowing a more clinically-relevant study population, the responses seen by dogs may more accurately reflect the effect seen in a typical veterinary practice setting (Mills et al., 2003).

Additional studies are needed to evaluate the use of DAP for treating canine thunderstorm phobia. Trials evaluating DAP in a more homogenous population of dogs may also be necessary. Although there was no statistical difference between the two treatment groups regarding concurrent medical conditions, it is possible that the population of dogs enrolled in the study accounted for the general lack of improvement from dog appeasing pheromone.

Conclusion

Compared to negative controls, DAP does not appear to be an effective treatment option for thunderstorm phobic dogs. The majority of clinical signs were unaffected by this treatment. While behaviors related to panting, cowering, and remaining near owners were significantly improved, the amount of improvement was to a lesser degree than that elicited from the placebo.

Further research is necessary to develop new and effective pharmacological or alternative therapies for canine thunderstorm phobia.

CHAPTER 5 - Conclusion

The previously discussed research studies have aimed at better understanding canine thunderstorm phobia. The results have shown that it is indeed a common behavioral problem with 52% of 463 dogs said to exhibit clinical signs. Moreover, it can result in a very distressing ending as 16.5% of relinquished dogs were thunderstorm phobic.

The first study sought to determine characteristics of thunderstorm phobic dogs and found that many were consistent with previous literature (Crowell-Davis et al., 2003; McCobb et al., 2001; Shull-Selcer and Stagg, 1991; Voith and Borchelt, 1985b). Sex, pedigree, breed, and neuter status did not appear to affect the development of this condition. Sources of thunderstorm phobic dogs were similar to a previous study, although they did not appear to affect thunderstorm phobia in the current study (McCobb et al., 2001). Many dogs fearful of storms were also afraid of other loud noises, which was consistent with data from Overall et al. (2001). Of the different treatment options available, many owners chose to use prescription medications with the most common being acepromazine, a sedative that is inappropriate for treating any type of noise phobia (Crowell-Davis and Murray, 2006, 152; Overall, 2002, 2001).

Differences were found between thunderstorm phobic dogs and those that were not. It appeared that severe weather warning systems may play a role in the progression of thunderstorm phobia, possibly through classical conditioning. Additionally, housing differed between affected and non-affected dogs, with more thunderstorm phobic dogs housed indoors. Although owners' behaviors did not seem to affect the fearful responses of dogs, owners' emotional states and behaviors did differ between the two populations of dogs. Interestingly, unaffected dogs were more commonly found in multiple-dog households.

The second study found that the number of dogs relinquished with thunderstorm phobia was relatively low. Other behavior problems, such as house-training mistakes and hyperactivity, resulted in a higher incidence. However, a sufficient number of thunderstorm phobic dogs were relinquished to indicate that a real problem exists. The other characteristics about relinquished dogs were consistent with previous studies (Line, 1998; Miller et al., 1996; Mondelli et al., 2004;

Patronek et al., 1996; Salman et al., 2000; Salman et al., 1998; Shore, 2005; Weng et al., 2006). Behavioral problems and unwanted litters of puppies were leading reasons for relinquishment. Sex did not appear to be a contributing factor, but small dogs or those used for sport were found to be more commonly surrendered. Nearly equal distributions of purebred and mixed breed dogs as well as sexually intact and neutered dogs were surrendered; however, greater numbers of mixed breed and intact dogs were relinquished which was consistent with previously discovered risk factors (Patronek et al., 1996). Sources of dogs, the cost to obtain dogs, and a lack of obedience training were also consistent with other studies (Miller et al., 1996; Patronek et al., 1996; Salman et al., 2000; Salman et al., 1998).

The final study determined the efficacy of a product known as dog appeasing pheromone (DAP). Unfortunately, the results of this study were not consistent with other studies as previous research had found favorable results using this product to treat anxiety and fear-based disorders (Estellés and Mills, 2006; Gaultier et al., 2005; Gaultier and Pageat, 2003; Levine et al., 2007; Mills et al., 2006; Sheppard and Mills, 2003; Taylor and Mills, 2007; Tod et al., 2005). The current research found only a few behaviors (panting, cowering, and remaining near owners) to be significantly affected by the pheromone, but the improvement seen was less significant than that observed with the placebo. Therefore, the administration of DAP does not appear to be a potential treatment for reducing or alleviating clinical signs associated with thunderstorm phobia when compared with negative controls.

It is clear from these three research studies that further research is indicated. First, there may have been an effect of multiple-dog households on not having thunderstorm phobia. As previous research indicated a lower stress response in thunderstorm phobic dogs housed together (Dreschel and Granger, 2005), further research needs to focus on the potential social learning that may occur between dogs with relation to thunderstorm phobia. Second, as the current study assessed thunderstorm phobia as a behavioral problem of relinquished dogs, further research needs to determine if it is a specific reason for relinquishment. A more detailed study could elucidate it as a controlling factor as opposed to a contributing factor. Lastly, future research should be conducted to assess other treatment options as DAP was found to be unsuccessful when compared to a placebo.

Together these studies have contributed to the scientific knowledge available on thunderstorm phobia. It has provided valuable information about the scope of this behavioral

problem in the general population as well as in dogs relinquished to animal shelters. This research lends credibility to and reinforces results found in previous literature. It has also emphasized the importance of proactive behavioral counseling to prevent the relinquishment of dogs to animal shelters and the need for future research into new and effective treatment methods.

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Appendix A - Survey and Cover Letter from Clinic-Based Study

Figure A.1 Front cover of 'You and Your Dog' survey

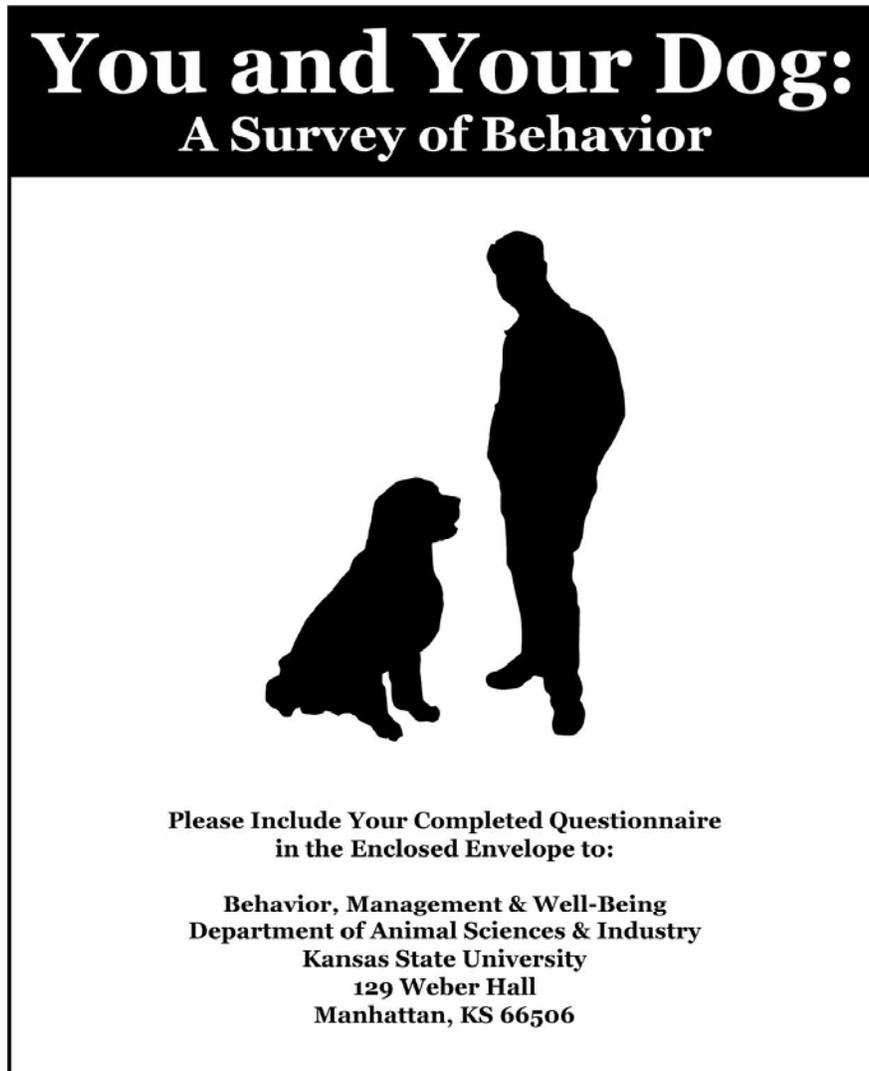


Figure A.2 Page 1 of 'You and Your Dog' survey

START HERE:

1. How many people are in your household?

- 1
- 2
- 3
- 4
- 5
- 6+

2. Are you or anyone in your household fearful of (or uncomfortable with) thunderstorm activity?

- No *Skip to Question #3*
- Yes

→ **2a. (If Yes) How many people in your household are fearful of (or uncomfortable with) thunderstorm activity?**

- 1
- 2
- 3
- 4
- 5
- 6+

2b. What relationship does the most fearful person in your household have to your dog(s)?

- Spends a lot of time with the dog(s).
- Spends some time with the dog(s).
- Spends no time with the dog(s).

Figure A.3 Page 2 of ‘You and Your Dog’ survey

3. When you or anyone in your household becomes aware of a thunderstorm approaching, do you make any of the following preparations before the storm arrives? (N/A = Not Applicable)

	Yes	No	N/A
Close windows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Make checks of the house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gather or secure outside furniture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Roll up sun shades or porch covers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Put cars in garage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gather children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gather pets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Check on other animals and/or livestock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watch weather/news station on television	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watch weather/news station on computer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Listen to weather/news station on radio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shout directions/orders for assistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watch storm approach from inside house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watch storm approach from outside house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3a. (If you answered Yes to any of the items in Question #3) Where is your dog(s) in relation to storm-preparation activity?

- Present during all activity
- Present during some of the activity
- Not present during any of the activity

Figure A.4 Page 3 of ‘You and Your Dog’ survey

4. To what extent do you experience the following before or during a thunderstorm?

	Very Great Extent	Moderate Extent	Not At All
Indifference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Calm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concern	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anxiousness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Panic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. How many dogs are in your household?

1
 2
 3
 4
 5+

If you have only one dog in your household, please continue to Question #6 and complete the questionnaire.

If you have more than one dog in your household, please fill out a separate questionnaire for each dog, starting with Question #6. You may disregard Questions 1 through 5 when filling out subsequent questionnaires.

Please provide your questionnaire ID numbers (printed on the cover of each survey) so that we can group your questionnaire responses together:

Your effort to complete a questionnaire for each of your dogs is greatly appreciated. Thank you for taking the time to assist us in learning more about canine thunderstorm phobia.

Figure A.5 Page 4 of ‘You and Your Dog’ survey

6. What is your dog’s name?

7. What breed is your dog?

Purebred (please specify)

Known mixed breed (please specify)

Unknown mixed breed

8. What sex is your dog?

Male

Female

9. Is your dog spayed or neutered?

No → *Skip to Question #10*

Yes

→ **9a. (If Yes) How old was your dog when it was spayed or neutered?**

Less than 6 months

6 months—1 year

1—3 years

3—5 years

5—7 years

Greater than 7 years

Figure A.6 Page 5 of ‘You and Your Dog’ survey

10. From where did you obtain your dog?

- Animal Shelter/Humane Society
 - Breed Rescue Organization
 - Pet Store
 - Breeder
 - Private owner (Non-breeder)
 - Veterinarian
 - Found stray
 - My dog’s own litter
 - Was a gift
 - Other (please specify)
-

11. Did you obtain your dog for any of the following reasons?

	Yes	No
Companionship	<input type="checkbox"/>	<input type="checkbox"/>
Breeding	<input type="checkbox"/>	<input type="checkbox"/>
Show	<input type="checkbox"/>	<input type="checkbox"/>
Protection	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

12. How old was your dog when you obtained it?

- 1—6 months
- 6 months—1 year
- 1—3 years
- 3—5 years
- 5—7 years
- 7—9 years
- Greater than 9 years

Figure A.7 Page 6 of ‘You and Your Dog’ survey

13. Approximately how old is your dog now?

- 1—6 months
- 6 months—1 year
- 1—3 years
- 3—5 years
- 5—7 years
- 7—9 years
- 9—11 years
- 11—13 years
- 13—15 years
- Greater than 15 years

14. Can your dog hear tornado sirens when they are activated?

- No → *Skip to Question #15*
- Yes

▶ **14a. (If Yes) What is your dog’s behavior when hearing tornado sirens during thunderstorm activity?**

- My dog is not fearful.
- My dog starts to act fearful.
- My dog is already fearful, but does not get more fearful.
- My dog is already fearful and gets more fearful.
- I do not know my dog’s behavior when the sirens are activated.

14b. What is your dog’s behavior when hearing tornado siren testing?

- My dog is not fearful.
- My dog starts to act fearful.
- My dog is already fearful, but does not get more fearful.
- My dog is already fearful and gets more fearful.
- I do not know my dog’s behavior when the sirens are activated.

Figure A.8 Page 7 of ‘You and Your Dog’ survey

15. Do you own a weather radio?

No *Skip to Question #16*

Yes

15a. (If Yes) Do you use your weather radio?

No *Skip to Question #16*

Yes

15b. (If Yes) What is your dog’s behavior when the weather radio goes off?

- My dog is not fearful.
- My dog starts to act fearful.
- My dog is already fearful, but does not get more fearful.
- My dog is already fearful and gets more fearful.
- I do not know my dog’s behavior when it goes off.

16. Do you keep your dog in any of the following locations during a typical day?

	Yes	No
Free-roaming inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Crated inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Restricted to a specific area inside my house	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

Figure A.9 Page 8 of ‘You and Your Dog’ survey

17. Do you keep your dog in any of the following locations during the night?

	Yes	No
Free-roaming inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Crated inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Restricted to a specific area inside my house	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

18. Do you keep your dog in any of the following locations during thunderstorm activity?

	Yes	No
Free-roaming inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Crated inside my house	<input type="checkbox"/>	<input type="checkbox"/>
Restricted to a specific area inside my house	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
In an outside enclosure, such as a kennel/fenced yard, without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Chained outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside with access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Free-roaming outside without access to shelter	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

Figure A.10 Page 9 of ‘You and Your Dog’ survey

19. Is your dog fearful of thunderstorm activity?

Yes → *(If Yes) Please continue with Question #20.*

No

(If No) It is not necessary for you to complete the remainder of this questionnaire. However, please return it in the enclosed business reply envelope so that we can include your answers in our research. Thank you for your time.

20. Does your dog prefer to spend its time during thunderstorm activity in any of the following locations?

	Yes	No
Indoors	<input type="checkbox"/>	<input type="checkbox"/>
Outdoors	<input type="checkbox"/>	<input type="checkbox"/>
With you or near you	<input type="checkbox"/>	<input type="checkbox"/>
Under a piece of furniture (i.e. sofa or bed)	<input type="checkbox"/>	<input type="checkbox"/>
Under a porch or deck	<input type="checkbox"/>	<input type="checkbox"/>
In a dark, windowless area (i.e. closet or cellar)	<input type="checkbox"/>	<input type="checkbox"/>
In its crate or dog house	<input type="checkbox"/>	<input type="checkbox"/>
In a bathtub or sink	<input type="checkbox"/>	<input type="checkbox"/>
Constantly moving from one location to another	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

Figure A.11 Page 10 of ‘You and Your Dog’ survey

21. Was your dog identified as being fearful of thunderstorm activity by any of the following people?

	Yes	No
You	<input type="checkbox"/>	<input type="checkbox"/>
A friend	<input type="checkbox"/>	<input type="checkbox"/>
A relative	<input type="checkbox"/>	<input type="checkbox"/>
A veterinarian	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

22. What age was your dog when you first noticed that it was fearful of thunderstorm activity?

- 1—6 months
- 6 months—1 year
- 1—3 years
- 3—5 years
- 5—7 years
- Greater than 7 years

23. Have you tried any of the following treatment options for your dog’s fearful behavior of thunderstorm activity? (If you don’t know, mark No.)

	Yes	No
Desensitization	<input type="checkbox"/>	<input type="checkbox"/>
Counterconditioning	<input type="checkbox"/>	<input type="checkbox"/>
Obedience training	<input type="checkbox"/>	<input type="checkbox"/>
Herbal remedies	<input type="checkbox"/>	<input type="checkbox"/>
Dog Appeasing Pheromone (D.A.P.)	<input type="checkbox"/>	<input type="checkbox"/>
Prescription medication (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

Figure A.12 Page 11 of 'You and Your Dog' survey

24. When do you observe changes in your dog's behavior relative to thunderstorm activity?

- Before the storm
 - During the storm
 - After the storm
- Skip to Question #25

→ 24a. (If Before the storm) Approximately how long before a storm do you see changes in your dog's behavior?

- Less than 30 minutes
- Between 30 minutes and 1 hour
- Between 1 and 3 hours
- Between 3 and 5 hours
- More than 5 hours

25. Do you do any of the following when your dog is fearful of thunderstorm activity?

- | | Yes | No |
|-----------------------------|--------------------------|--------------------------|
| I try to reassure my dog. | <input type="checkbox"/> | <input type="checkbox"/> |
| I try to ignore my dog. | <input type="checkbox"/> | <input type="checkbox"/> |
| I try to distract my dog. | <input type="checkbox"/> | <input type="checkbox"/> |
| I try to discipline my dog. | <input type="checkbox"/> | <input type="checkbox"/> |

→ 25a. (If Yes to any of the items in Question #25) In response to your reactions, does your dog's behavior do any of the following?

- | | Yes | No |
|------------------|--------------------------|--------------------------|
| Improve a lot | <input type="checkbox"/> | <input type="checkbox"/> |
| Improve slightly | <input type="checkbox"/> | <input type="checkbox"/> |
| Remain the same | <input type="checkbox"/> | <input type="checkbox"/> |
| Worsen slightly | <input type="checkbox"/> | <input type="checkbox"/> |
| Worsen a lot | <input type="checkbox"/> | <input type="checkbox"/> |

Figure A.13 Page 12 of ‘You and Your Dog’ survey

26. Please indicate the intensity of your dog’s fearful behavior in relation to the following noise-producing situations.

	No Reaction	Mild	Moderate	Severe	Unknown
Fireworks	<input type="checkbox"/>				
Gun shots	<input type="checkbox"/>				
Cars backfiring	<input type="checkbox"/>				
Vacuum cleaners	<input type="checkbox"/>				
Ft. Riley artillery	<input type="checkbox"/>				
Planes	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

27. Please indicate the intensity of your dog’s fearful behavior in relation to the following weather situations.

	No Reaction	Mild	Moderate	Severe	Unknown
Wind	<input type="checkbox"/>				
Hail	<input type="checkbox"/>				
Light rain only	<input type="checkbox"/>				
Heavy rain only	<input type="checkbox"/>				
Rain & thunder	<input type="checkbox"/>				
Thunder only	<input type="checkbox"/>				
Lightening & thunder	<input type="checkbox"/>				
Lightening only (no audible thunder)	<input type="checkbox"/>				

Figure A.14 Page 13 of 'You and Your Dog' survey

28. We now turn to behaviors that some dogs may exhibit in response to thunderstorm activity. For each behavior, *first* indicate the frequency with which your dog displays the behavior. *If* the behavior never occurs, then continue to the next behavior. *If* the behavior occurs at any frequency, then go to the right-hand section and indicate its intensity.

	Frequency					Intensity		
	Never Observed	Seldom Observed	Sometimes Observed	Often Observed	Always Observed	Mild	Moderate	Severe
Yawning	<input type="checkbox"/>							
Lip licking	<input type="checkbox"/>							
Panting	<input type="checkbox"/>							
Dilated pupils	<input type="checkbox"/>							
Excessive salivating	<input type="checkbox"/>							
Increased alertness	<input type="checkbox"/>							
Shaking/Trembling	<input type="checkbox"/>							
Whimpering/Whining	<input type="checkbox"/>							
Barking	<input type="checkbox"/>							
Howling	<input type="checkbox"/>							

Continued on next page.

Figure A.15 Page 14 of 'You and Your Dog' survey

Question 28 continued:

	Frequency					Intensity		
	Never Observed	Seldom Observed	Sometimes Observed	Often Observed	Always Observed	Mild	Moderate	Severe
Uncontrollable urination	<input type="checkbox"/>							
Uncontrollable defecation	<input type="checkbox"/>							
Increased activity	<input type="checkbox"/>							
Decreased activity	<input type="checkbox"/>							
Soliciting attention	<input type="checkbox"/>							
Remaining near you	<input type="checkbox"/>							
Attempting to escape	<input type="checkbox"/>							
Property destruction	<input type="checkbox"/>							
Self-Injury	<input type="checkbox"/>							
Unresponsive	<input type="checkbox"/>							
Collapsing	<input type="checkbox"/>							
Hiding	<input type="checkbox"/>							

Figure A.16 Back cover of ‘You and Your Dog’ survey

If you would like a copy of the results of this questionnaire, please provide your contact information below.

Name: _____

Street Address: _____

City: _____

State: _____ Zip: _____

Thank you for taking the time to complete this questionnaire. Your assistance in providing this information is truly appreciated. If you have any additional comments or would like to share anything else about this survey, please do so in the space provided below.

Please fold your completed questionnaire in half and return in the envelope provided to:

Behavior, Management & Well-Being
Department of Animal Sciences & Industry
Kansas State University
129 Weber Hall
Manhattan, KS 66506

Figure A.17 Cover letter included with ‘You and Your Dog’ survey



Animal Sciences and Industry
K-State Research and Extension
232 Weber Hall
Manhattan, KS 66506 -0201
785-532-6533
Fax: 785-532-7059

Dear Dog Owner,

Thank you for volunteering to participate in this important study regarding thunderstorm phobia in dogs. This study is part of an effort to learn more about distinguishing characteristics of phobic and non-phobic dogs, as well as any factors that may affect the development of this behavioral problem.

You have been asked to participate in this study because you are a dog owner. It is not necessary that your dog have a fear of thunderstorm activity. In fact, we hope you will take the time to complete the enclosed questionnaire regardless of your dog having or not having thunderstorm phobia. If your dog is fearful of thunderstorms, you may want to observe your dog during the next thunderstorm to help you answer the last question of the survey.

If you have multiple dogs in your household, we ask that you complete a separate questionnaire for each dog. You can skip the first five questions on subsequent questionnaires. Since each questionnaire will be returned in a separate envelope, we ask that you write each questionnaire identification number (printed on the cover) in the space provided within the survey so that we can record your responses as a group.

Results from the study will be used to help understand the complex nature of canine thunderstorm phobia. By understanding what may cause or predispose a dog to have this behavioral problem, better treatment options for affected dogs may be developed.

Your responses will be kept confidential and will be reported only as summaries in which no individual's answers can be identified. If you choose to give your contact information at the end of the questionnaire, this information will be used only to send you a copy of the results and will not be shared with any other person or organization. This survey is voluntary. You may decline to complete the survey or stop at any time. However, we hope you will take the time to help us with this research study. Your consent is implied by your completion and return of the questionnaire.

If you have any questions or comments, please let us know by calling 785/532-1089 or by sending an email to kari@wallentine.com. If you have any concerns about this study, please contact Rick Scheidt, Institutional Review Board Chairman at 785/532-3224.

Thank you very much for your time and effort to complete the questionnaire.

Sincerely,

Kari D. Wallentine, DVM
Graduate Student
Behavior, Management & Well-Being
Department of Animal Sciences & Industry
Kansas State University
129 Weber Hall
Manhattan, KS 66506

Janice C. Swanson, Ph.D.
Interim Head
Behavior, Management & Well-Being Leader
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Kansas State University
Agricultural Experiment
Station and Cooperative
Extension Service

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Appendix B - Survey and Cover Letter from Shelter-Based Study

Figure B.1 Front cover of 'Why Dogs are Put up for Adoption' survey

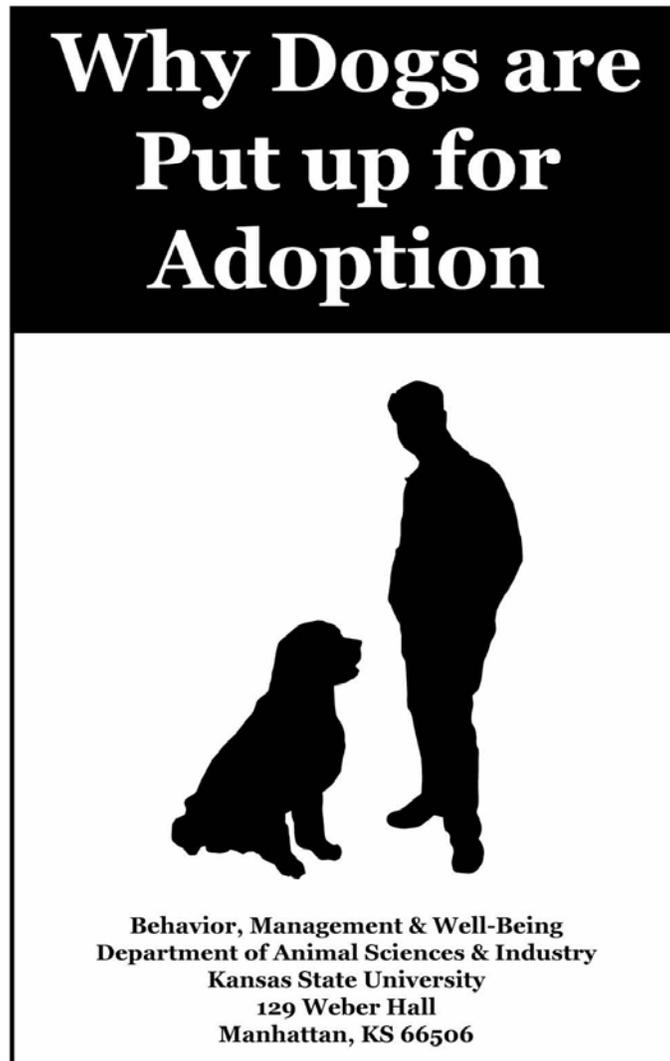


Figure B.2 Page 1 of 'Why Dogs are Put up for Adoption' survey

START HERE:

1. Are you releasing your dog(s) to the shelter today for any of the following reasons?

	Yes	No
Moving	<input type="checkbox"/>	<input type="checkbox"/>
Too expensive	<input type="checkbox"/>	<input type="checkbox"/>
Too much work	<input type="checkbox"/>	<input type="checkbox"/>
Time-consuming	<input type="checkbox"/>	<input type="checkbox"/>
Owner illness	<input type="checkbox"/>	<input type="checkbox"/>
Dog illness	<input type="checkbox"/>	<input type="checkbox"/>
Dog old age	<input type="checkbox"/>	<input type="checkbox"/>
Behavior problem	<input type="checkbox"/>	<input type="checkbox"/>
New baby	<input type="checkbox"/>	<input type="checkbox"/>
Unwanted litter	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>

If you answered Yes to Unwanted litter, it is not necessary for you to complete the remainder of this questionnaire. Please place your questionnaire in the return box so that we can include your answer in our research. Thank you for your time.

Figure B.3 Page 2 of 'Why Dogs are Put up for Adoption' survey

2. Does your dog have any of the following behavioral problems?

	Yes	No
Aggression towards people	<input type="checkbox"/>	<input type="checkbox"/>
Aggression towards animals	<input type="checkbox"/>	<input type="checkbox"/>
House-training mistakes	<input type="checkbox"/>	<input type="checkbox"/>
Destructiveness outdoors	<input type="checkbox"/>	<input type="checkbox"/>
Destructiveness indoors	<input type="checkbox"/>	<input type="checkbox"/>
Separation anxiety	<input type="checkbox"/>	<input type="checkbox"/>
Obsessive-compulsive behavior	<input type="checkbox"/>	<input type="checkbox"/>
Fear of people/strangers	<input type="checkbox"/>	<input type="checkbox"/>
Fear of thunder	<input type="checkbox"/>	<input type="checkbox"/>
Fear of other loud noises	<input type="checkbox"/>	<input type="checkbox"/>
Escaping	<input type="checkbox"/>	<input type="checkbox"/>
Digging	<input type="checkbox"/>	<input type="checkbox"/>
Excessive barking	<input type="checkbox"/>	<input type="checkbox"/>
Disobedient	<input type="checkbox"/>	<input type="checkbox"/>
Overactive	<input type="checkbox"/>	<input type="checkbox"/>
Wants too much attention	<input type="checkbox"/>	<input type="checkbox"/>
Does not get along with other pets	<input type="checkbox"/>	<input type="checkbox"/>

➔ **2a. (If you answered Yes to any of the items in Question #2, please answer the next 3 questions) Was your dog identified as having a behavioral problem by any of the following people?**

	Yes	No
By you	<input type="checkbox"/>	<input type="checkbox"/>
By a friend	<input type="checkbox"/>	<input type="checkbox"/>
By a relative	<input type="checkbox"/>	<input type="checkbox"/>
By a veterinarian	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

Figure B.4 Page 3 of ‘Why Dogs are Put up for Adoption’ survey

2b. Have you consulted a veterinarian about your dog’s behavioral problem(s)?

- Yes
- No

2c. Have you tried any of the following treatment options for your dog’s behavioral problem(s)? (If you don’t know, mark No.)

	Yes	No
Obedience training	<input type="checkbox"/>	<input type="checkbox"/>
Desensitization	<input type="checkbox"/>	<input type="checkbox"/>
Counterconditioning	<input type="checkbox"/>	<input type="checkbox"/>
Prescription medications	<input type="checkbox"/>	<input type="checkbox"/>
Herbal remedies	<input type="checkbox"/>	<input type="checkbox"/>

3. What breed is your dog?

- Purebred (please specify)

- Known mixed breed (please specify)

- Unknown mixed breed

4. What sex is your dog?

- Male
- Female

Figure B.5 Page 4 of ‘Why Dogs are Put up for Adoption’ survey

5. Is your dog spayed or neutered?

No *Skip to Question #6*

Yes

5a. (If Yes) At what age was your dog spayed or neutered?

Less than 6 months

6 months—1 year

1—3 years

3—5 years

5—7 years

Greater than 7 years

6. From where did you obtain your dog?

Animal shelter/Humane society

Breed rescue organization

Pet store

Breeder

Private owner (non-breeder)

Veterinarian

Found stray

My dog's own litter

Was a gift

Other (please specify)

Figure B.6 Page 5 of ‘Why Dogs are Put up for Adoption’ survey

7. Approximately how much was the cost to purchase your dog?

- Free
- \$1—\$50
- \$51—\$100
- Greater than \$100

8. Did you obtain your dog for any of the following reasons?

	Yes	No
Companionship	<input type="checkbox"/>	<input type="checkbox"/>
Breeding	<input type="checkbox"/>	<input type="checkbox"/>
Show	<input type="checkbox"/>	<input type="checkbox"/>
Protection	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>

9. How old was your dog when you obtained it?

- 1—6 months
- 6 months—1 year
- 1—3 years
- 3—5 years
- 5—7 years
- 7—9 years
- 9—11 years
- 11—13 years
- 13—15 years
- Greater than 15 years

Figure B.7 Page 6 of ‘Why Dogs are Put up for Adoption’ survey

10. How old is your dog now?

- 1—6 months
- 6 months—1 year
- 1—3 years
- 3—5 years
- 5—7 years
- 7—9 years
- 9—11 years
- 11—13 years
- 13—15 years
- Greater than 15 years

11. Has your dog received any obedience training?

- Yes
- No

12. Have you seen a veterinarian during the past year for your dog’s healthcare needs?

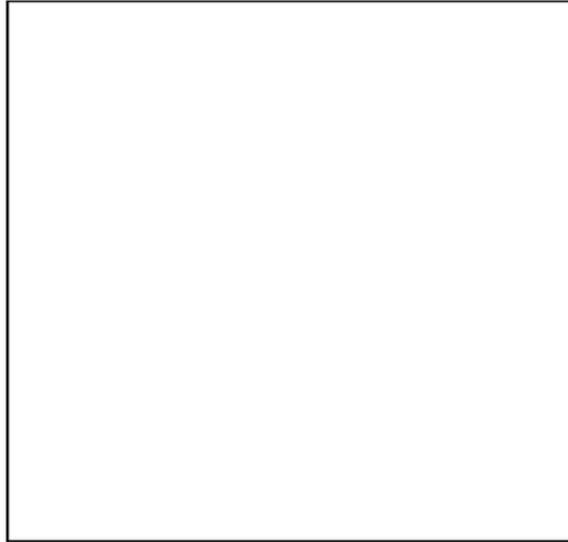
- Yes
- No

13. Do you have any other pets in your household?

- Yes
- No

Figure B.8 Back cover of ‘Why Dogs are Put up for Adoption’ survey

Thank you for taking the time to complete this questionnaire.
Your assistance in providing this information is truly
appreciated. If you have any additional comments or would like
to share anything else about this survey, please do so in the space
provided below.

A large, empty rectangular box with a thin black border, intended for respondents to provide additional comments or feedback on the survey.

*Please seal your completed questionnaire in the manila envelope
and drop in the return box.*

Figure B.9 Cover letter included with ‘Why Dogs are Put up for Adoption’ survey



Animal Sciences and Industry
K-State Research and Extension
232 Weber Hall
Manhattan, KS 66506-0201
785-532-6533
Fax: 785-532-7059

Dear Dog Owner,

Thank you for volunteering to participate in this important research study regarding pets that have to be released to an animal shelter. You have been asked to participate in this study because you are a dog owner.

This study is part of an effort to learn about the characteristics of dogs that are released to animal shelters. Results from the study will be used to help understand what types of dogs are released to shelters and for what reasons. Knowing this information may help those of us in the animal care profession to focus our efforts in ways that can help decrease the number of pets in shelters.

Your answers are completely anonymous. We will have no way to connect you and your answers. The results will be reported only as summaries in which no individual's answers can be identified. Your responses will in no way affect the adoption of your dog(s). This survey is voluntary. You may decline to complete the survey or stop at any time. However, you can help us by taking the time to complete this survey. Your consent is implied by your completion and return of the questionnaire. After completing the questionnaire, please seal it in the manilla envelope and drop it in the return box.

If you have any questions or comments, please let us know by calling 785/532-1089 or sending an email to kari@wallentine.com. If you have any concerns about this study, please contact Rick Scheidt, Institutional Review Board Chairman at 785/532-3224.

Thank you very much for your time and effort to complete the survey.

Sincerely,

Kari D. Wallentine, DVM
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Janice C. Swanson, Ph.D.
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Extension Service

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Appendix C - Recruitment for Shelter-Based Study

Figure C.1 Letter to animal shelter staff

November 21, 2006



Animal Sciences and Industry
K-State Research and Extension
232 Weber Hall
Manhattan, KS 66506 -0201
785-532-6533
Fax: 785-532-7059

Dear Animal Shelter staff,

Thank you for assisting me with my research study. This study is part of an effort to learn about the characteristics of dogs that are relinquished to animal shelters.

This research study involves distributing surveys to owners of dogs that are releasing their pet to your shelter. Each survey is enclosed in an unsealed envelope with a letter explaining the study. Please encourage dog owners to complete this short and simple survey, using the clipboards and pens I have provided. It can be filled out during the time it takes to process their relinquishment paperwork. After completing the survey, encourage owners to seal their survey in the envelope and drop it in the collection box.

The survey is voluntary. The participants' answers are anonymous. Please assure owners that I will be the only person reading their responses to the survey, and their answers will not affect the outcome of their dog(s).

Please feel free to read through a blank survey and the letter accompanying it in order to familiarize yourself with what I have asked owners to complete. Questions in the survey are short and ask for basic information, such as breed, sex, age of the dog, and why it is being relinquished.

Results from the completed surveys will help all of us in the animal care profession focus our efforts in ways that decrease the number of pets in shelters.

If you have any questions, please don't hesitate to contact me at 785/532-1089 or kari@wallentine.com.

Thanks again for your help with this project! It's only with your help that this research can be successful.

Sincerely,

Kari D. Wallentine, DVM
Behavior, Management, & Well-Being
Department of Animal Sciences & Industry
Kansas State University
129 Weber Hall
Manhattan, KS 66502

Kansas State University
Agricultural Experiment
Station and Cooperative
Extension Service

*"Knowledge
for Life"*

Figure C.2 Poster encouraging participation in shelter-based study

If you have gone through the
difficult decision of putting
your dog up for adoption, **we**
would like
to know
why

Please consider taking
our anonymous survey.

It's short & simple,
taking less than 5 minutes.

*Your answers will not be
read by the shelter staff or
affect your dog's adoption*

Your answers are important to us!

Thank you for your help!



Appendix D - Recruitment for Clinical Trial

Figure D.1 Poster recruiting dogs for participation in clinical trial



Is your dog
AFRAID
of thunderstorms ?

Would you like to participate in a clinical trial at K-State testing a new treatment for thunderstorm phobia?

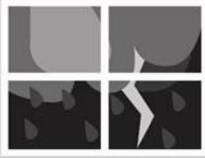
If so, please contact Dr. Kari Wallentine at (785) 532-1089 for more information.



KSTATE
Kansas State University

Figure D.2 Newspaper advertisement recruiting dogs for participation in clinical trial

Is your dog
AFRAID
of thunderstorms?



Would you like to
participate in a clinical trial at
K-State testing a new treatment
for thunderstorm phobia?



Contact Dr. Kari Wallentine at (785) 532-1089

Appendix E - Canine History Evaluation Questionnaire

Figure E.1 Page 1 of canine history evaluation questionnaire



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 Behavior, Management,
 & Well-Being
 Animal Sciences & Industry
 Kansas State University
 134C Weber Hall
 Manhattan, KS 66506
 785/532-1089
 kari@wallentine.com

Canine History Evaluation Questionnaire

Owner Information:	
Name	
Address	
Home Phone Number	
Work Phone Number	
Email Address	
Veterinarian/Clinic	
Referred by (or how found out about study)	
Dog Information:	
Name	
Breed	
Sex	<input type="checkbox"/> Male <input type="checkbox"/> Female
Neutered	<input type="checkbox"/> Yes <input type="checkbox"/> No
Date of Birth	
Age	
Weight	
Any other pets in household?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) Please specify	
When was your dog's last veterinary check-up?	
When was your dog last vaccinated?	
Does your dog have any physical problems that your veterinarian has noted (i.e. major surgeries, medical problems)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) What specifically (approx. dates)?	
Does your dog have any current medical problems?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) What specifically?	

Figure E.2 Page 2 of canine history evaluation questionnaire



Does your dog have any behavioral problems that you or your veterinarian have noted?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If yes)</i> What specifically (approx. dates)?	
Is your dog currently taking any prescription medications?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If yes)</i> What are the medications, including dosage, schedule, & indication?	
Is your dog taking any herbal remedies or supplements?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If yes)</i> What are the remedies/supplements, including dosage, schedule, & indication?	
Is your dog taking heartworm preventative?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is your dog on flea/tick preventative?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Figure E.3 Page 3 of canine history evaluation questionnaire



What percentage of a 24-hour day does your dog spend inside?	
What percentage of a 24-hour day does your dog spend outside?	
What kind of living situation do you have?	
Describe where your dog stays at each of the following times:	
Day time (owner away)	
Day time (owner home)	
Night time	
Thunderstorm Phobia Assessment:	
Does your dog react fearfully to thunderstorms?	<input type="checkbox"/> Yes <input type="checkbox"/> No
How was your dog identified as being fearful of thunderstorm activity?	<input type="checkbox"/> By you <input type="checkbox"/> By a friend <input type="checkbox"/> By a relative <input type="checkbox"/> By a veterinarian <input type="checkbox"/> Other (<i>please specify</i>)
How long has your dog responded fearfully towards thunderstorm activity?	
How often does your dog react fearfully to thunderstorms?	<input type="checkbox"/> Never (0% of time) <input type="checkbox"/> Rarely (0-40% of time) <input type="checkbox"/> Sometimes (40-60% of time) <input type="checkbox"/> Often (60-100% of time) <input type="checkbox"/> Always (100% of time)
Does your dog prefer to spend its time during thunderstorm activity in any of the following locations?	<input type="checkbox"/> Indoors <input type="checkbox"/> Outdoors <input type="checkbox"/> With you or near you <input type="checkbox"/> Under a piece of furniture (i.e. sofa, bed) <input type="checkbox"/> Under a porch or deck <input type="checkbox"/> In a dark, windowless area (i.e. closet, cellar) <input type="checkbox"/> In its crate or dog house <input type="checkbox"/> In a bathtub or sink <input type="checkbox"/> Constantly moving from 1 location to another <input type="checkbox"/> Other (<i>please specify</i>)

Figure E.4 Page 4 of canine history evaluation questionnaire



<p>Does your dog react fearfully to any of the following weather situations?</p>	<p><input type="checkbox"/> Wind <input type="checkbox"/> Hail <input type="checkbox"/> Light rain only <input type="checkbox"/> Heavy rain only <input type="checkbox"/> Rain & thunder <input type="checkbox"/> Thunder only <input type="checkbox"/> Lightening only (no audible thunder) <input type="checkbox"/> Lightening & thunder</p>
<p>Does your dog have any of the following responses to thunderstorm activity?</p>	<p><input type="checkbox"/> Yawning <input type="checkbox"/> Lip licking <input type="checkbox"/> Panting <input type="checkbox"/> Excessive salivation <input type="checkbox"/> Increased alertness <input type="checkbox"/> Shaking/ trembling <input type="checkbox"/> Whimpering/ whining <input type="checkbox"/> Howling <input type="checkbox"/> Barking <input type="checkbox"/> Uncontrollable urination <input type="checkbox"/> Uncontrollable defecation <input type="checkbox"/> Increased activity <input type="checkbox"/> Decreased activity <input type="checkbox"/> Soliciting attention <input type="checkbox"/> Remaining near you <input type="checkbox"/> Attempting to escape <input type="checkbox"/> Property destruction <input type="checkbox"/> Self-injury <input type="checkbox"/> Unresponsive <input type="checkbox"/> Hiding (<i>specify where</i>)</p>
<p>Overall, how would you rate your dog's response to thunderstorm activity?</p>	<p><input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe</p>
<p>Have you tried any of the following treatment options for your dog's fearful behavior of thunderstorms?</p>	<p><input type="checkbox"/> Desensitization <input type="checkbox"/> Counter-conditioning <input type="checkbox"/> Obedience training <input type="checkbox"/> Herbal remedies (<i>please specify</i>) <input type="checkbox"/> Dog Appeasing Pheromone (DAP) <input type="checkbox"/> Prescription medication (<i>please specify</i>) <input type="checkbox"/> Other (<i>please specify</i>)</p>
<p>Were any of these treatment options successful?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>(<i>If yes</i>) Which ones?</p>	

Figure E.5 Page 5 of canine history evaluation questionnaire



Did any of these treatment options make the problem worse?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) Which ones?	
Separation Anxiety Assessment:	
During an <i>actual absence</i> (owner actually leaves the house & the dog is alone or totally w/o the owner), does your dog display any of the following behaviors?	<input type="checkbox"/> Destructive behavior <input type="checkbox"/> Urination <input type="checkbox"/> Defecation <input type="checkbox"/> Vocalization <input type="checkbox"/> Salivation
During a <i>virtual absence</i> (owner is home, but separated by a door or another room), does your dog display any of the following behaviors?	<input type="checkbox"/> Destructive behavior <input type="checkbox"/> Urination <input type="checkbox"/> Defecation <input type="checkbox"/> Vocalization <input type="checkbox"/> Salivation
When you are home with your dog, does it display any of the following behaviors?	<input type="checkbox"/> Destructive behavior <input type="checkbox"/> Urination <input type="checkbox"/> Defecation <input type="checkbox"/> Vocalization <input type="checkbox"/> Salivation
Aggression Assessment:	
Has your dog bitten any human?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) Did the bite(s) break the skin?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Has your dog bitten any other domestic animal?	<input type="checkbox"/> Yes <input type="checkbox"/> No
(If yes) Did the bite(s) break the skin?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Does your dog act aggressively in any of the following situations? (Acting aggressively = snarling, aggressive barking/growling, snapping, or biting)	<input type="checkbox"/> Take dog's food dish <input type="checkbox"/> Take rawhide or toy away <input type="checkbox"/> Human approaches dog while eating <input type="checkbox"/> Dog approaches dog while eating <input type="checkbox"/> Human approaches dog while playing w/ toys <input type="checkbox"/> Dog approaches dog while playing w/ toys <input type="checkbox"/> Human approaches/disturbs dog while asleep <input type="checkbox"/> Dog approaches/disturbs dog while asleep <input type="checkbox"/> Reach over dog's head <input type="checkbox"/> Stranger enters room <input type="checkbox"/> Dog on leash approached by person on street <input type="checkbox"/> Dog on leash approached by dog on street <input type="checkbox"/> Dog in yard person passes <input type="checkbox"/> Dog in yard dog passes <input type="checkbox"/> Dog in vet's office <input type="checkbox"/> Dog in boarding kennel <input type="checkbox"/> Dog at groomers <input type="checkbox"/> Squirrels, cats, small animals approach <input type="checkbox"/> Crying infant

Figure E.6 Page 6 of canine history evaluation questionnaire



Canine History Evaluation Questionnaire

Fireworks Fear Assessment:	
Is your dog afraid of fireworks?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Does your dog react the same way to fireworks as it does to thunderstorms?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If no)</i> How is your dog's response to fireworks different from that of thunderstorms?	
Overall, how would you rate your dog's response to fireworks?	<input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe
Have you tried any of the following treatment options for your dog's fearful behavior to fireworks?	<input type="checkbox"/> Desensitization <input type="checkbox"/> Counter-conditioning <input type="checkbox"/> Obedience training <input type="checkbox"/> Herbal remedies <i>(please specify)</i> <input type="checkbox"/> Dog Appeasing Pheromone (DAP) <input type="checkbox"/> Prescription medication <i>(please specify)</i> <input type="checkbox"/> Other <i>(please specify)</i>
Were any of these treatment options successful?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If yes)</i> Which ones?	
Did any of these treatment options make the problem worse?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>(If yes)</i> Which ones?	

Figure E.7 Page 7 of canine history evaluation questionnaire



Cognitive Dysfunction Assessment: <i>(For dogs over 7 years old)</i>	
Does your dog do any of the following?	<input type="checkbox"/> Wander aimlessly <input type="checkbox"/> Appear lost or confused in house or yard <input type="checkbox"/> Stare into space or at walls <input type="checkbox"/> Has difficulty finding the door to go out <input type="checkbox"/> Does not recognize familiar people <input type="checkbox"/> Does not respond to verbal cues or name (but still able to hear)
	<input type="checkbox"/> Sleeps more (overall) in a 24-hour day <input type="checkbox"/> Sleeps less during the night <input type="checkbox"/> Decrease in (purposeful) activity in a 24-hr day <input type="checkbox"/> Increase in aimless activity (wanders, paces) in a 24-hr day
<i>(If previously housetrained)</i>	<input type="checkbox"/> Urinates indoors <input type="checkbox"/> Defecates indoors <input type="checkbox"/> Urinates or defecates indoors in view of owners <input type="checkbox"/> Urinates or defecates indoors soon after being outside <input type="checkbox"/> Signals less to go outside (if previously signaled)
	<input type="checkbox"/> Solicits less attention <input type="checkbox"/> Less likely to stand/lie for petting (i.e. walks away) <input type="checkbox"/> Less enthusiasm upon greeting <input type="checkbox"/> No longer greets owner (once aware they have arrived)
Comments:	
Screens:	
Thunderstorm phobia	<input type="checkbox"/> Yes <input type="checkbox"/> No
Separation anxiety	<input type="checkbox"/> Yes <input type="checkbox"/> No
Aggression	<input type="checkbox"/> Yes <input type="checkbox"/> No
Cognitive Dysfunction	<input type="checkbox"/> Yes <input type="checkbox"/> No
Acceptable for inclusion	<input type="checkbox"/> Yes <input type="checkbox"/> No

Appendix F - Physical Examination Form

Figure F.1 Page 1 of physical examination form



Kari D. Wallentine, DVM
 Behavior, Management,
 & Well-Being
 Animal Sciences & Industry
 Kansas State University
 134C Weber Hall
 Manhattan, KS 66506
 785/532-1089
 kari@wallentine.com

Physical Examination Form

Owner Information:	
Name	
Address	
Home Phone Number	
Work Phone Number	
Email Address	
Veterinarian/Clinic	
Dog Information:	
Name	
Breed	
Sex	
Neutered	
Date of Birth	
Age	
Weight	

Temperature: _____ °F Heart Rate: _____ (bpm) Resp. Rate: _____
 Hydration: _____ Pulse Rate: _____

	Normal	Abnormal	Not Examined
General Appearance			
Integumentary System			
Mucous Membranes			
Oral Cavity			
Eyes			
Ears			
Lymph Nodes			
Respiratory System			
Cardiovascular System			
Digestive System			
Reproductive System			
Urinary System			
Musculoskeletal System			
Nervous System			

Figure F.2 Page 2 of physical examination form



Any current medical problems?

Any vomiting or diarrhea?

Any coughing or sneezing?

Urinating and defecating normally?

Normal appetite?

Comments:

Clinically Healthy Yes No

Acceptable for Inclusion Yes No

Appendix G - Owner Instructions Form

Figure G.1 Owner instructions form



Kari D. Wallentine, DVM
Behavior, Management,
& Well-Being
Animal Sciences & Industry
Kansas State University
134C Weber Hall
Manhattan, KS 66506
785/532-1089
kari@wallentine.com

Owner Instructions

- Complete Behavior Assessment Questionnaire #1 either during or after a thunderstorm has occurred.
- Then assemble (see instructions below) and plug in the electric diffuser in an area of your home where your dog spends the majority of its time. Plug the diffuser in an open area. Do not place underneath or behind furniture.
- Follow the instructions and record thunderstorm activity on the Thunderstorm Diary.
- Every two weeks, please complete another Behavioral Assessment Questionnaire. If, according to the Thunderstorm Diary, there have been no thunderstorms in a two week period, please leave the corresponding questionnaire blank.
- Halfway through the study, please refill the diffuser by replacing the vial.
- At the end of the eight week study period, please return your questionnaires, diary, and diffuser to us.

Instructions for Use of the Diffuser:

1. Remove the vial cap.
2. Screw the diffuser onto the vial and gently tighten.
3. Plug the diffuser into an electric socket.



The diffuser should cover approximately 500-650 sq. ft. One vial should last approximately four weeks. The vial should be replaced after four weeks, even though some of the fluid may still remain.

Instructions for Handling your Dog's Fearful Behavior:

1. Do not punish your dog when it is scared. This may confirm that there is something to be afraid of and may worsen your dog's behavior.
2. Do not try to reassure your dog when it is scared. This may reward the fearful behavior and may worsen your dog's behavior.
3. Instead, try to ignore your dog's behavior during thunderstorms.

Precautions:

- Keep out of reach of children.
- Do not cover.
- Check that the main voltage is the same as indicated on the device.
- When plugged in, do not touch the device with metal objects or with wet hands.
- The surfaces of the device reach high temperatures to encourage evaporation of the vial's contents. These surfaces should not be touched during use of the product.
- In case of contact with eyes, wash them immediately with water and seek the advice of a physician.
- Avoid contact with the skin. In case of contact with the skin, wash thoroughly with soap and water.
- If the product is swallowed, consult a doctor immediately.

Appendix H - Behavioral Assessment Questionnaire #1

Figure H.1 Page 1 of behavioral assessment questionnaire #1



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Behavioral Assessment Questionnaire #1

For each behavior listed below, first indicate the frequency with which your dog displays the behavior (for instance, how often does your dog perform the behavior during thunderstorms?). If the behavior never occurs, then continue to the next behavior. If the behavior occurs at any frequency, then please indicate its intensity (for instance, what is the severity of the behavior being performed?).

1. Yawning

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional yawning)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous yawning)

2. Panting

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional panting)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous panting)

3. Excessive salivating (drooling)

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (damp around mouth)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (pools of saliva)

4. Increased alertness

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional scanning of environment)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous scanning of environment)

Figure H.2 Page 2 of behavioral assessment questionnaire #1



5. Shaking/Trembling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (barely visible)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (dramatic; very visible)

6. Cowering

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (uneasy; nervous)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (terrified)

7. Whimpering/Whining

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

8. Howling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

9. Barking

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

Figure H.3 Page 3 of behavioral assessment questionnaire #1



10. Aggression

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (growling)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (snapping; biting)

11. Uncontrollable urination and/or defecation

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount)

12. Increased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (more active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (excessive, continuous activity)

13. Decreased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (less active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (unresponsive)

14. Soliciting attention from you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally seeking attention)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously seeking attention)

Figure H.4 Page 4 of behavioral assessment questionnaire #1



15. Remaining near you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally near you)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously near you)

16. Attempting to escape

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional attempts)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous attempts)

17. Property destruction

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount of damage)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount of damage)

18. Self-Injury

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small degree of harm)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large degree of harm)

19. Hiding

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (leaves to hide, but may return)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (leaves to hide & remains hidden)

Appendix I - Thunderstorm Diary

Figure I.1 Page 1 of thunderstorm diary



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Thunderstorm Diary

Before starting the study, please fill out Questionnaire #1 during or after a thunderstorm has occurred. After completing Questionnaire #1, please plug in the diffuser, indicating so by marking the small box and writing the date in the box below labeled Day 1. This marks the first day of the study. Start recording thunderstorm activity on this calendar by marking Yes or No if a thunderstorm occurs each day. Please record the date where indicated. Follow additional instructions for Days 14, 28, 29, 42, and 56, and mark off corresponding small boxes.

Day 1 Date: _____ <input type="checkbox"/> Plug in Diffuser Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 2 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 3 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 4 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 5 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 6 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 7 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 8 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 9 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 10 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 11 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 12 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 13 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 14 <input type="checkbox"/> Complete Questionnaire #2 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 15 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 16 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 17 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 18 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 19 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 20 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 21 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 22 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 23 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 24 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 25 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 26 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 27 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 28 <input type="checkbox"/> Complete Questionnaire #3 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No

Continued on other side

Figure I.2 Page 2 of thunderstorm diary



Thunderstorm Diary

Please continue recording thunderstorm activity on this calendar by marking Yes or No if a thunderstorm occurs each day. Please record the date where indicated. Follow additional instructions for Days 29, 42, and 56, and mark off corresponding small boxes.

Day 29 Date: _____ <input type="checkbox"/> Refill Diffuser Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 30 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 31 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 32 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 33 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 34 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 35 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 36 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 37 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 38 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 39 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 40 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 41 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 42 <input type="checkbox"/> Complete Questionnaire #4 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 43 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 44 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 45 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 46 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 47 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 48 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 49 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No
Day 50 Date: _____ Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 51 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 52 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 53 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 54 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 55 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No	Day 56 <input type="checkbox"/> Complete Questionnaire #5 Thunderstorm? <input type="checkbox"/> Yes <input type="checkbox"/> No

After completing this diary and Questionnaire #5, please return all of the questionnaires, the diary, and the diffuser to Dr. Kari Wallentine.

Appendix J - Behavioral Assessment Questionnaires #2 - #4

Figure J.1 Page 1 of behavioral assessment questionnaire #2



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Behavioral Assessment Questionnaire #2

For each behavior listed below, first indicate the frequency with which your dog displays the behavior (for instance, how often has your dog performed the behavior during thunderstorms during the past two weeks?). If the behavior never occurs, then continue to the next behavior. If the behavior occurs at any frequency, then please indicate its intensity (for instance, what is the severity of the behavior being performed?). If there haven't been any thunderstorms in the past two weeks, please leave the questionnaire blank.

1. Yawning

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional yawning)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous yawning)

2. Panting

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional panting)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous panting)

3. Excessive salivating (drooling)

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (damp around mouth)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (pools of saliva)

4. Increased alertness

Frequency:
<input type="checkbox"/> Never (0% of time)
<input type="checkbox"/> Rarely (0-40% of time)
<input type="checkbox"/> Sometimes (40-60% of time)
<input type="checkbox"/> Often (60-100% of time)
<input type="checkbox"/> Always (100% of time)

Intensity:
<input type="checkbox"/> Mild (occasional scanning of environment)
<input type="checkbox"/> Moderate
<input type="checkbox"/> Severe (continuous scanning of environment)

Figure J.2 Page 2 of behavioral assessment questionnaire #2



5. Shaking/Trembling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (barely visible)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (dramatic; very visible)

6. Cowering

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (uneasy; nervous)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (terrified)

7. Whimpering/Whining

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

8. Howling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

9. Barking

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

Figure J.3 Page 3 of behavioral assessment questionnaire #2



10. Aggression

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (growling)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (snapping; biting)

11. Uncontrollable urination and/or defecation

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount)

12. Increased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (more active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (excessive, continuous activity)

13. Decreased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (less active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (unresponsive)

14. Soliciting attention from you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally seeking attention)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously seeking attention)

Figure J.4 Page 4 of behavioral assessment questionnaire #2



15. Remaining near you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally near you)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously near you)

16. Attempting to escape

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional attempts)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous attempts)

17. Property destruction

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount of damage)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount of damage)

18. Self-Injury

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small degree of harm)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large degree of harm)

19. Hiding

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (leaves to hide, but may return)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (leaves to hide & remains hidden)

Figure J.5 Page 1 of behavioral assessment questionnaire #3



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Behavioral Assessment Questionnaire #3

For each behavior listed below, first indicate the frequency with which your dog displays the behavior (for instance, how often has your dog performed the behavior during thunderstorms during the past two weeks?). If the behavior never occurs, then continue to the next behavior. If the behavior occurs at any frequency, then please indicate its intensity (for instance, what is the severity of the behavior being performed?). If there haven't been any thunderstorms in the past two weeks, please leave the questionnaire blank.

1. Yawning

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional yawning)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous yawning)

2. Panting

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional panting)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous panting)

3. Excessive salivating (drooling)

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (damp around mouth)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (pools of saliva)

4. Increased alertness

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional scanning of environment)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous scanning of environment)

Figure J.6 Page 2 of behavioral assessment questionnaire #3



5. Shaking/Trembling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (barely visible)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (dramatic; very visible)

6. Cowering

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (uneasy; nervous)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (terrified)

7. Whimpering/Whining

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

8. Howling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

9. Barking

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

Figure J.7 Page 3 of behavioral assessment questionnaire #3



10. Aggression

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (growling)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (snapping; biting)

11. Uncontrollable urination and/or defecation

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount)

12. Increased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (more active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (excessive, continuous activity)

13. Decreased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (less active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (unresponsive)

14. Soliciting attention from you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally seeking attention)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously seeking attention)

Figure J.8 Page 4 of behavioral assessment questionnaire #3



15. Remaining near you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally near you)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously near you)

16. Attempting to escape

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional attempts)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous attempts)

17. Property destruction

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount of damage)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount of damage)

18. Self-Injury

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small degree of harm)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large degree of harm)

19. Hiding

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (leaves to hide, but may return)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (leaves to hide & remains hidden)

Figure J.9 Page 1 of behavioral assessment questionnaire #4



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Behavioral Assessment Questionnaire #4

For each behavior listed below, first indicate the frequency with which your dog displays the behavior (for instance, how often has your dog performed the behavior during thunderstorms during the past two weeks?). If the behavior never occurs, then continue to the next behavior. If the behavior occurs at any frequency, then please indicate its intensity (for instance, what is the severity of the behavior being performed?). If there haven't been any thunderstorms in the past two weeks, please leave the questionnaire blank.

1. Yawning

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional yawning)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous yawning)

2. Panting

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional panting)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous panting)

3. Excessive salivating (drooling)

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (damp around mouth)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (pools of saliva)

4. Increased alertness

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional scanning of environment)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous scanning of environment)

Figure J.10 Page 2 of behavioral assessment questionnaire #4



5. Shaking/Trembling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (barely visible)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (dramatic; very visible)

6. Cowering

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (uneasy; nervous)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (terrified)

7. Whimpering/Whining

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

8. Howling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

9. Barking

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

Figure J.11 Page 3 of behavioral assessment questionnaire #4



10. Aggression

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (growling)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (snapping; biting)

11. Uncontrollable urination and/or defecation

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount)

12. Increased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (more active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (excessive, continuous activity)

13. Decreased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (less active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (unresponsive)

14. Soliciting attention from you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally seeking attention)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously seeking attention)

Figure J.12 Page 4 of behavioral assessment questionnaire #4



15. Remaining near you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally near you)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously near you)

16. Attempting to escape

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional attempts)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous attempts)

17. Property destruction

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount of damage)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount of damage)

18. Self-Injury

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small degree of harm)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large degree of harm)

19. Hiding

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (leaves to hide, but may return)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (leaves to hide & remains hidden)

Appendix K - Behavioral Assessment Questionnaire #5

Figure K.1 Page 1 of behavioral assessment questionnaire #5



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Behavioral Assessment Questionnaire #5

For each behavior listed below, first indicate the frequency with which your dog displays the behavior (for instance, how often has your dog performed the behavior during thunderstorms during the past two weeks?). If the behavior never occurs, then continue to the next behavior. If the behavior occurs at any frequency, then please indicate its intensity (for instance, what is the severity of the behavior being performed?). If there haven't been any thunderstorms in the past two weeks, please leave the questionnaire blank.

1. Yawning

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional yawning)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous yawning)

2. Panting

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional panting)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous panting)

3. Excessive salivating (drooling)

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (damp around mouth)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (pools of saliva)

4. Increased alertness

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional scanning of environment)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous scanning of environment)

Figure K.2 Page 2 of behavioral assessment questionnaire #5



5. Shaking/Trembling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (barely visible)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (dramatic; very visible)

6. Cowering

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (uneasy; nervous)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (terrified)

7. Whimpering/Whining

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

8. Howling

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

9. Barking

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (soft & quiet)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (loud)

Figure K.3 Page 3 of behavioral assessment questionnaire #5



10. Aggression

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (growling)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (snapping; biting)

11. Uncontrollable urination and/or defecation

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount)

12. Increased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (more active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (excessive, continuous activity)

13. Decreased activity

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (less active than normal)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (unresponsive)

14. Soliciting attention from you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally seeking attention)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously seeking attention)

Figure K.4 Page 4 of behavioral assessment questionnaire #5



15. Remaining near you

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasionally near you)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuously near you)

16. Attempting to escape

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (occasional attempts)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (continuous attempts)

17. Property destruction

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small amount of damage)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large amount of damage)

18. Self-Injury

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (small degree of harm)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (large degree of harm)

19. Hiding

Frequency:	
<input type="checkbox"/>	Never (0% of time)
<input type="checkbox"/>	Rarely (0-40% of time)
<input type="checkbox"/>	Sometimes (40-60% of time)
<input type="checkbox"/>	Often (60-100% of time)
<input type="checkbox"/>	Always (100% of time)

Intensity:	
<input type="checkbox"/>	Mild (leaves to hide, but may return)
<input type="checkbox"/>	Moderate
<input type="checkbox"/>	Severe (leaves to hide & remains hidden)

Appendix L - Informed Consent Form

Figure L.1 Page 1 of informed consent form



Kari D. Wallentine, DVM
Behavior, Management,
& Well-Being
Animal Sciences & Industry
Kansas State University
134C Weber Hall
Manhattan, KS 66506
785/532-1089
kari@wallentine.com

Informed Consent Form

Project Title:
A Potential Treatment for Canine Thunderstorm Phobia

Approval Date of Project: March 27, 2007
Expiration Date of Project: March 27, 2010

Researchers:
Kari D. Wallentine, DVM
Janice C. Swanson, PhD
Thomas Schermerhorn, VMD, DACVIM

Contact Information for any Problems/Questions:
785-532-1089
kari@wallentine.com

Institutional Review Board Chair Contact Information:
Rick Scheidt
785/532-3224

Sponsor of Project:
Ceva Animal Health USA, Inc.

Purpose of Research:
You are being asked to participate in a research study. The purpose of this study is to assess the effectiveness of a product with the potential for treating dogs with thunderstorm phobia.

Inclusion in Research:
You have been selected to participate in this research study because your dog has met the necessary criteria to be a subject in this study.

Research Methods:
As a participant, you will be asked to fill out five questionnaires that describe your dog's behavior during thunderstorms. The first questionnaire will be filled out before the study starts. Then you will be asked to expose your dog to either the product or a placebo by plugging in the electrical diffuser in your house in an area where your dog spends the majority of its time. You will be asked to complete an additional questionnaire every two weeks. You will also be asked to keep a diary of when thunderstorms occur during the study. Halfway through the study, you will be asked to refill the diffuser. You will also be given guidelines about how to treat your dog during thunderstorms, such as ignoring your dog's fearful behavior. At the end of the study, you will be asked to return the questionnaires, diary, and the diffuser.

This is a double-blind study meaning that neither you nor the researchers will know whether you have been given the product or the placebo.

Length of Study:
Eight weeks

Figure L.2 Page 2 of informed consent form for Greystone Animal Hospital location



Location of Study:

The physical examination of your dog will take place in Greystone Animal Hospital.

The study itself will take place in your home. You will be asked to plug in a diffuser into an area of your home where your dog spends the majority of its time.

Risks Anticipated:

There are no known harmful risks for you and your dog to be exposed to the product or the placebo. However, as with any electric device, there is the risk of harm if not used properly. You will be provided with a list of precautions to minimize these potential risks. Additionally, there is a time commitment required for completing each questionnaire and the diary.

Benefits Anticipated:

Positive results from this study would offer another treatment option for thunderstorm phobic dogs.

Extent of Confidentiality:

The completed questionnaires and diaries will be protected following the study. Only the researchers will view and have access to the completed questionnaires and diaries, which will be securely stored in Weber Hall at Kansas State University. Results will be reported as a summary, with no individual participants being identified.

Terms of Participation:

I understand this project is research and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation or penalty.

I understand that Greystone Animal Hospital is only providing facilities for the physical examination of my dog and that the hospital is not responsible for any part of this study. I understand that if I have any medical problems or concerns, or questions about the study, I should contact Dr. Kari D. Wallentine at the contact information provided on this form.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

Participant Signature: _____ Date: _____

Witness to Signature: _____ Date: _____

Figure L.3 Page 2 of informed consent form for Kansas State University's Veterinary Medical Teaching Hospital location



Location of Study:

The physical examination of your dog will take place in Kansas State University's Veterinary Medical Teaching Hospital.

The study itself will take place in your home. You will be asked to plug in a diffuser into an area of your home where your dog spends the majority of its time.

Risks Anticipated:

There are no known harmful risks for you and your dog to be exposed to the product or the placebo. However, as with any electric device, there is the risk of harm if not used properly. You will be provided with a list of precautions to minimize these potential risks. Additionally, there is a time commitment required for completing each questionnaire and the diary.

Benefits Anticipated:

Positive results from this study would offer another treatment option for thunderstorm phobic dogs.

Extent of Confidentiality:

The completed questionnaires and diaries will be protected following the study. Only the researchers will view and have access to the completed questionnaires and diaries, which will be securely stored in Weber Hall at Kansas State University. Results will be reported as a summary, with no individual participants being identified.

Terms of Participation:

I understand this project is research and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation or penalty.

I understand that Kansas State University's Veterinary Medical Teaching Hospital is only providing facilities for the physical examination of my dog and that the hospital and its staff is not responsible for any part of this study. I understand that if I have any medical problems or concerns, or questions about the study, I should contact Dr. Kari D. Wallentine at the contact information provided on this form and not the Veterinary Medical Teaching Hospital.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

Participant Signature: _____ Date: _____

Witness to Signature: _____ Date: _____

Figure L.4 Page 2 of informed consent form for house calls



Location of Study:

The physical examination of your dog will take place in your home.

The study itself will also take place in your home. You will be asked to plug in a diffuser into an area of your home where your dog spends the majority of its time.

Risks Anticipated:

There are no known harmful risks for you and your dog to be exposed to the product or the placebo. However, as with any electric device, there is the risk of harm if not used properly. You will be provided with a list of precautions to minimize these potential risks. Additionally, there is a time commitment required for completing each questionnaire and the diary.

Benefits Anticipated:

Positive results from this study would offer another treatment option for thunderstorm phobic dogs.

Extent of Confidentiality:

The completed questionnaires and diaries will be protected following the study. Only the researchers will view and have access to the completed questionnaires and diaries, which will be securely stored in Weber Hall at Kansas State University. Results will be reported as a summary, with no individual participants being identified.

Terms of Participation:

I understand this project is research and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation or penalty.

I understand that if I have any medical problems or concerns, or questions about the study, I should contact Dr. Kari D. Wallentine at the contact information provided on this form.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

Participant Signature: _____ Date: _____

Witness to Signature: _____ Date: _____