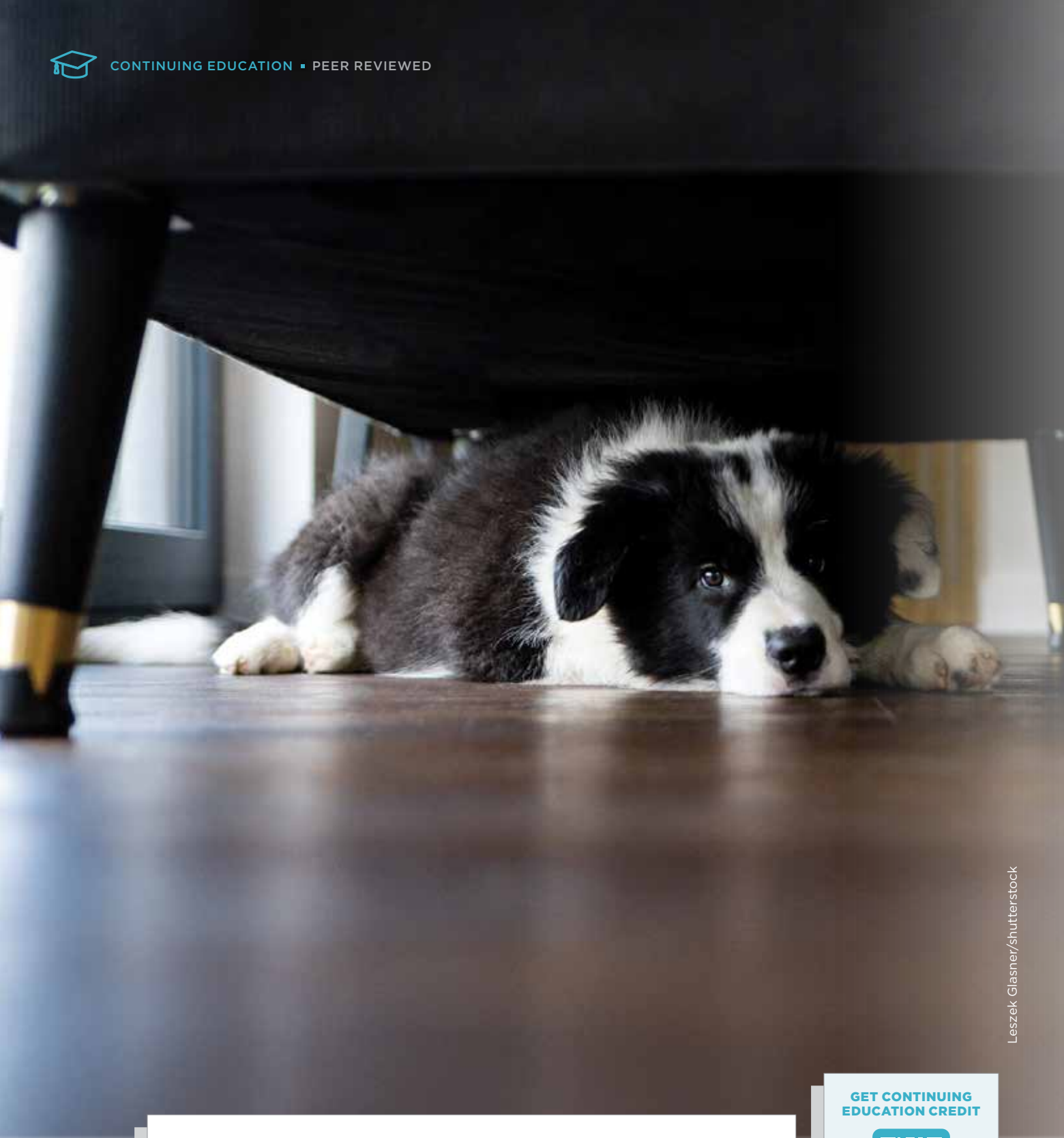




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Topic Overview

This article covers the hypothesized development and diagnosis of storm phobia, as well as a step-by-step, multimodal treatment approach. It also discusses the role of pain in noise aversions such as storm phobia. The treatment plan for storm phobia includes environmental management, behavior modification, and medication for immediate treatment. Additional steps for longer-term management, including taking advantage of the winter to begin systematic desensitization and counterconditioning, are also described.

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BEHAVIOR

Storm Phobia in Dogs

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Storm phobia is a serious behavior disorder based on a maladaptive fear response that is out of proportion to the level of danger a storm poses to the individual. The resulting impact on the welfare of canine patients is profoundly negative. Some dogs sustain physical injuries such as lacerations to the face and paws and damage to teeth and gums during attempts to hide or escape. Owners are also negatively affected, often reporting sleep deprivation, financial burdens due to property destruction, and emotional suffering as they watch their dog in distress. In this way, storm phobias damage the human–animal bond, increase the risk of relinquishment by the owner, and even lead to behavioral euthanasia.

This article provides general practitioners with information to confidently diagnose storm phobia and develop a comprehensive treatment plan that is simple enough for most owners to implement.

THE ROLE OF FEAR

Fear is an innate emotional response that helps keep an individual safe from danger. Fear triggers a biological stress response comprising 4 integrated components: an autonomic component, a behavior component, a neuroendocrine component of the hypothalamic–pituitary–adrenal (HPA) axis response, and an immune component.

The sympathetic branch of the autonomic nervous system releases norepinephrine and epinephrine, which create an immediate physiologic response and drive behavior changes (**TABLE 1**). Cortisol release by the HPA axis aids in the immediate fight-or-flight response, although chronic or frequent stimulation can lead to medical and behavioral consequences associated with chronic stress. In this way, chronic fear not only impairs the immune system but also contributes to poor welfare.¹

Learning Objectives

- Behavioral treatment plans for storm phobia should be simple enough for owners to follow, yet still include all the steps needed to be efficacious.
- Safe spots are essential parts of the treatment plan.
- Classical counterconditioning can be implemented immediately.
- Fast-acting situational medications can be key to helping maintain adequate patient welfare during storms.
- Adding a baseline antidepressant medication early on can help facilitate progress with treatment and preservation of the human–animal bond, especially in areas where storms are frequent or unpredictable.
- Systematic desensitization must only be implemented outside of storm season.

TABLE 1 Autonomic Fear Responses

PHYSIOLOGIC RESPONSES	ACTIVE BEHAVIORAL SIGNS	PASSIVE BEHAVIORAL SIGNS
■ Tachycardia ■ Tachypnea/panting ■ Dilated pupils ■ Muscle tension ■ Salivation ■ Anorexia ■ Elimination (urine or feces)	■ Aggression (fight) ■ Escape attempt (flight) ■ Restlessness/pacing (fidget) ■ Vocalization ■ Visual scanning/hypervigilance ■ Destructiveness ■ Seeking contact with humans or other animals	■ Tonic immobility (freeze) ■ Flattened ears ■ Hiding ■ Trembling ■ Lowered body posture ■ Low tail position

In the wild, most fear responses are adaptive, lasting only long enough for the animal to avoid or escape a threat. When a dog cannot escape a trigger or the trigger persists frequently or for extended periods, the fear response can become prolonged and magnified. The result can be a maladaptive fear, which interferes with normal function and is a hallmark of phobias.¹ Because fear is a necessary, lifesaving emotion, it does not take many repetitions for the brain to quickly associate threatening stimuli with fear and consequent behavior via conditioning. This conditioning can lead the dog to learn that nonlethal stimuli, like thunder and other associated signs of storms, are to be feared. Once the dog has made the negative association, it becomes difficult for the brain to “unlearn” the associated negative stimulus.²

In storm phobia, fear and its consequent stress response occur in close temporal association with the sound of thunder.³ The response to thunder may be more intense for dogs due to their superior sense of hearing. Lightning may also induce fear, as bright flashes can cause temporary loss of vision for more than an hour.⁴ Because anticipation of a threatening event can be innately lifesaving, frightened dogs are especially adept at making associations with the environmental conditions that predict an impending storm. This could explain why some dogs with storm phobia display behavioral signs of fear (**TABLE 1**) before a storm begins. Contextual clues such as darkening skies, gusts of wind, the scent of ozone, barometric pressure changes, and even rain alone can induce panic in dogs before the storm arrives. Dogs with storm phobia might continue to display fearful behavior for hours to days after the storm has passed.

DIAGNOSING STORM PHOBIA

Medical conditions such as pain, endocrine disorders, cardiopulmonary disease, neurologic problems, and cognitive dysfunction syndrome can contribute to or exacerbate behavior problems.⁵ Thus, it is critical to

systematically work up cases of suspected storm phobia in the same manner as all medical conditions. A detailed history and thorough physical examination are essential. A CBC; serum biochemical profile; urinalysis; and endocrine testing, such as a thyroid panel, should be evaluated to help rule out underlying conditions presenting as, or exacerbating, anxiety and to assess organ function prior to prescribing medications.

Signalment

Storm phobia is generally a straightforward diagnosis, based on the **GLOSSARY** definition. Noise aversions commonly begin to manifest as noise sensitivities. This can occur as early as 8 weeks of age, but the typical recorded median onset of phobia is around 2 years of age.⁷ Breed risk associations have been made in some studies, but these often correlate with common breeds in the specific geographic location of the study. Regardless of geographic location, mixed-breed dogs are often listed among the top breeds affected by noise aversions.^{8,9} Results correlating noise aversions to sex or neuter status have been inconsistent.¹⁰

The Role of Pain

Musculoskeletal pain can contribute significantly to noise aversions and fears in dogs, including those with storm phobia. When the sympathetic nervous system responds to a fear-inducing trigger, muscles tense for fight or flight. Tensing muscles and joints that are already painful due to musculoskeletal disease in response to unexpected noise, such as thunder, can cause the brain to associate the noise with exacerbated physical pain.

One study reported that dogs with musculoskeletal pain were more likely to present with fear occurring in the presence of a wider range of sounds and environments and to avoid other dogs.¹¹ The researchers also noted that dogs with concurrently diagnosed musculoskeletal pain were identified at a

later age (mean age, 6.5 years) than dogs without identified musculoskeletal pain (fear identified at a mean age of 2 years, 8 months).¹¹ Although the study was small, it highlights the importance of evaluating for subtle signs of musculoskeletal pain in dogs older than 6 years presenting for noise aversion. Treating the inciting cause of pain along with the behavior complaint could very well improve noise aversion and reduce generalization to fear of other noise stimuli.¹⁰⁻¹³

Comorbidities

Noise phobia, storm phobia, confinement distress, and separation anxiety are often comorbid behavioral conditions.² There is evidence that the occurrence of 1 problem affects the likelihood of the occurrence of others.¹⁴ However, this finding is not consistent among all studies.^{5,8,15} Because of the canine biologic stress response (**TABLE 1**), many of the clinical signs owners report for noise phobia, separation anxiety, and storm

phobia are the same, making it difficult to discern which problem is the inciting cause.^{2,14}

Accurate diagnosis of storm phobia relies on asking specific history questions about the timing of the dog's behavior surrounding noises and storms and during the owner's presence and absence. Reviewing video recordings of the dog when it is alone during noise events and without them will help discern if separation anxiety is also present.

To be effective, treatment must address all comorbid conditions, which may make it complex.¹⁶ Treatment of these more complicated cases can often benefit from the guidance of a board-certified veterinary behavior specialist (dacvb.org).

THE 5 STEPS OF TREATMENT

Treatment of storm phobia aims to change the dog's emotional state during storms; to teach the dog more adaptive coping strategies during the event; and, long-term, to teach the dog to pay less attention to stimuli associated with the storm. To accomplish this, the dog's environment must be adapted to reduce visual and auditory stimuli associated with storms, behavior modification exercises must be implemented, and medications often need to be prescribed to address the fear-induced stress response.

Treatment plans during storm season differ from those during nonstorm season. Immediate treatment during storm season includes managing the environment to reduce trigger exposure, behavior modification in the form of counterconditioning, and fast-acting psychopharmaceuticals. However, additional treatment steps can be added outside of storm season to help prevent recrudescence in the spring. These include (systematic) desensitization and counterconditioning (DSCC) and, often, longer-term antidepressant medications.¹⁴

The steps below follow a commonly utilized 5-step treatment plan.¹⁷

Immediate Treatment During Storm Season

STEP 1. Trigger Avoidance

Avoiding triggers enhances safety, reduces stress for dogs and their owners, and helps prevent the

Glossary

Noise sensitivity Low-level, adaptive fear response to unexpected noise. As in a startle reaction, the dog displays a heightened alert response to the sound but recovers rapidly once the sound has stopped.

Noise aversion Encompasses the entire range of a dog's negative emotional and behavioral response(s) to noise. Noise sensitivity, noise phobia, and storm phobia can all fall into this general category. Noises that commonly trigger an aversion include thunder, fireworks, gunshots, vacuum cleaners, and loud vehicle sounds.²

Noise phobia Maladaptive response to a variety of sounds. The response is out of proportion to the level of threat the trigger represents, and the dog remains frightened for an extended period, often described as poor recovery. Noise phobias interfere with the dog's ability to function normally and pose a significant welfare concern.

Storm phobia Maladaptive fear response specifically to storms. It is distinct from noise phobia because the dog often begins to display clinical signs consistent with fear from the appearance of contextual clues before the arrival of a storm. Not all dogs that have noise phobia have storm phobia, although many dogs with storm phobia also have noise phobia.⁶



development of undesirable associations. During storm season, since exposure is unpredictable and often unavoidable, the focus is on modifying the environment to reduce sensory input from the storm. This can be accomplished by creating a “safe spot” or modifying the dog’s preferred hiding location. The goal is to create a calm, secure environment that minimizes exposure to storm-related sights and sounds. To accomplish this, the owner can block the sight of lightning flashes and the sound of thunder by utilizing increased lighting; adding curtains, blankets, or covers; and adding ambient sound (see **STEP 3** for more details).

STEP 2. Relationship Building

Consistent, positive interactions and predictability are keys to building a strong human–animal bond and trust between dogs and their owners. However, it is very natural for owners to be frustrated when a frightened dog keeps them up at night or destroys property, and it is common for them to try to control the dog through punishment, use of aversive tools (e.g., shock collars), and negative interactions (e.g., yelling at the dog). These actions can intensify the fear surrounding storms, as the dog will learn that storms also predict punishment.¹⁸ Therefore, although the situation is challenging, the owners must not take their frustration out on the dog.

Cue-response-reward is a positive, predictable interaction pattern that owners can use in average, everyday interactions to strengthen the bond with their dog (**HANDOUT 1**). It is not intended to be used during storms. This pattern helps strengthen cued behaviors (formerly known as commands) and teaches dogs to trust owners and look to owners for guidance. If the owner wishes to interact with the dog, they can first ask for a cue, and if the dog performs it, the dog gets a reward, such as petting or a treat. If the dog does not perform the behavior, the owner simply ignores the dog. If needed, the owner can ask again later (e.g., 15 seconds up to 2 minutes) using a higher-value

reinforcer. This interaction pattern helps the dog feel safer because if they are too anxious to perform the behavior, nothing bad happens, making the owners more predictable. When owners initiate all interactions in a consistent pattern by asking for a cue first, resulting in only pleasant outcomes for their dog, the dog learns what to expect from them and trusts that they will follow that predictable pattern.

STEP 3. Tool Implementation

Tools include any items needed to facilitate trigger avoidance, environmental management, or behavior modification. For dogs with storm phobia, creating a safe spot is critical to help shield them from the sights and sounds associated with storms. A good recommendation is to ensure the safe spot is ready in advance when there is a 40% or higher chance of storms.

The safe spot can be a basement; interior room; closet; bathroom; or, if the dog tolerates confinement, crate (**FIGURE 1A**). If the dog already seeks out a particular area, it is often reasonable to enhance that location rather than introduce a new one. Owners should choose a space with few or no windows to reduce visual triggers like darkening skies and lightning. If windows are present, they can be covered with blackout curtains or closed blinds (**FIGURE 1B**).

White noise machines, fans, background television, or music can help reduce auditory triggers like thunder. Classical music, soft rock, *Through a Dog’s Ear*, and easy-listening jazz have shown some evidence of helping promote calm behavior.^{19–22} A heavy blanket placed over a crate or acoustic foam mounted on walls or around a crate can also help dampen the auditory stimuli associated with thunder, rain, and wind.

The space can be made more comfortable with a soft bed, favorite toys, and high-value treats or long-lasting chews (**FIGURE 1C**). These items can also support behavior modification by pairing storms with positive experiences (classical counterconditioning).

Establishing a supportive safe spot reduces sensory overload, provides predictability, and helps shift the dog’s emotional response to storms from fear to a more pleasant experience.

STEP 4. Behavior Modification

Behavior modification techniques involve classical



HANDOUT 1

Follow this link for a client handout on cue-response-reward.



FIGURE 1. In creating a safe spot, simple supplies like blankets and cardboard can be used to decrease auditory and visual cues of storms. **(A)** A crate is placed away from the wall and a moving blanket placed on top. **(B)** Cardboard is used to cover the window. **(C)** A comfortable bed and toys are placed inside the crate.

counterconditioning, operant counterconditioning, and DSCC. For dogs with storm phobia, the goals are to change the dog's fearful emotional state and teach the dog alternate coping strategies, including relaxation. While classical conditioning and operant conditioning are explained separately, it is important to remember that they often occur simultaneously²² and can be paired with systematic desensitization to create DSCC exercises. For immediate treatment during storms, classical counterconditioning is most practical.

Classical Counterconditioning

Classical counterconditioning aims to shift a dog's emotional response from fear to a more neutral or positive state by pairing a pleasurable experience with the aversive stimulus. During thunderstorms, this often involves offering the most delicious high-value treat immediately following each clap of thunder. The dog's ability to eat the treats indicates their fear level; refusal to eat suggests excessive fear at a level that hinders learning, while acceptance indicates a starting point and potential for learning new associations with the trigger. For dogs that are not motivated by food, alternatives like praise, attention, gentle petting, play, or training can be employed. If an owner is unable to actively pair each clap of thunder with a discrete treat, a long-lasting chew or treat toy can be offered during a storm instead. This technique can be implemented immediately upon recognition of the storm phobia.

Operant Counterconditioning

Operant counterconditioning, also known as response substitution, can give dogs alternative behavior patterns to engage in when they would otherwise start to display anxious or fearful behavior. With some planning, this technique can be used during storm season, within a few days to weeks of initial diagnosis. In general, the owner initiates response substitution by asking the dog for a behavior that is physically incompatible with the undesired behavior. Response substitution alone will not change the dog's emotional response; to achieve this goal, the alternative behavior should be paired with a high-value food treat (classical counterconditioning).

For response substitution to be successful, it is important to first teach alternative behaviors (coping strategies) outside of frightening situations.²² In an owner survey regarding dogs with noise aversion, 69% of pet owners responded that relaxation exercises (type not specified) were effective for their dogs with fireworks fear.²³ Training dogs to go to a specific place (bed, mat, or safe spot) using positive reinforcement is a foundation for many relaxation behaviors (**HANDOUT 2**). Many clinicians also include training a dog to take a deep breath on cue as a way to help the dog learn to calm. Deep breathing helps to slow heart rate and lower blood pressure, and, in humans, it has been demonstrated to decrease pain.²⁴ These behaviors can then be put together, with the result being a relaxed settle, where the dog lies laterally or with legs to the side on its mat and takes deep breaths. The dog can

**HANDOUT 2**

Follow this link for a client handout on teaching relaxation behaviors.

then be rewarded for additional calm or relaxed behaviors or body postures in the safe spot. Response substitution for a dog with storm phobia could be described as the owner asking for a “settle” when they notice their dog beginning to pace due to fear or anxiety. This is helpful because a dog cannot pace and settle at the same time.

STEP 5. Pharmaceutical and Adjunct Treatments

During thunderstorm season, fast-acting situational medications should be administered to manage immediate fear responses in dogs (**TABLE 2**). These medications help improve the dog’s emotional state during a storm and offer a smoother transition when starting baseline medications (see **STEP 5** under **LONG-TERM MANAGEMENT**). Apart from Sileo (Zoetis, zoetis.com), all these medications should be given before the onset of the storm and fear response to have optimal effect, and a dosing trial is typically required to find the appropriate dose and duration. Acepromazine can increase noise sensitivity and is not recommended for managing noise aversions.¹⁴

α_2 Agonists

α_2 Agonists bind to presynaptic α_2 receptors in the locus coeruleus to inhibit the release of norepinephrine and decrease the physiological signs associated with the fight-or-flight response. The 2 most frequently used drugs in this class are dexmedetomidine and clonidine.

Sileo (Zoetis, zoetis.com) is an oral transmucosal gel formulation of dexmedetomidine that is FDA-approved for the treatment of noise aversion in dogs. Gruen et al found the efficacy of Sileo to be similar for several noise triggers, including thunder.²⁸ However, Sileo is not explicitly labeled for thunderstorms. This medication is unique in that it can be dosed either prior to a noise event or after the noise and fear have begun and still reduce the fear response. The onset of action is fast, usually within 20 to 30 minutes, and the drug has few adverse effects when dosed according to the label.²⁹

Clonidine is an α_2 agonist with a wide dose range in tablet form.

Anticonvulsant Drugs

Gabapentin and imepitoin (Pexion; Boehringer Ingelheim, nexion.co.uk) are medications that were first used as anticonvulsant drugs. Though their mechanisms of action are not fully understood, in addition to reducing seizures, they are now known to have anxiolytic properties. Pexion received FDA approval for noise aversion in dogs in 2018. Its use showed significant decreases in fear and anxiety during storms and other noise events.³⁰ However, it is currently unavailable in the United States.

Gabapentin can help manage anxiety and is especially helpful for dogs that might also experience neuropathic pain in association with noise phobia. At higher doses, it can cause sedation, which can sometimes be a useful side effect, particularly during storms. Gabapentin can also be paired with selective serotonin reuptake inhibitors (SSRIs) or tricyclic antidepressants (TCAs) to help control and reduce arousal and reactivity.²⁵

Benzodiazepines

Benzodiazepines bind to γ -aminobutyric acid type A (GABA_A) receptors in the central nervous system to potentiate GABA. They have historically been used as anticonvulsants, but published use includes management of storm phobia in dogs.²⁷ Many benzodiazepines can be beneficial in the management of storm phobia.

Benzodiazepines are true anxiolytic medications and can be used alone or as adjunct medications. They are particularly helpful as anxiolytics because they can have an amnesic effect that inhibits learning, including negative associations, and can be helpful for panic behaviors. They might cause paradoxical excitability, polyphagia, increased food seeking, and sedation. Use with concurrent diagnoses of aggression is controversial due to the potential risk of behavioral disinhibition, which could include disinhibiting aggression.

The optimum dose of benzodiazepines in each dog varies greatly, as they generally have wide dosing ranges. Therefore, it is recommended to use a test dose at the lower end of the dosing range while the owner is present to observe their dog, systematically increasing the dose to effect over several trial doses.²⁷

Trazodone

Trazodone acts as both a serotonin 2A (5-HT_{2A}) and 2B (5-HT_{2B}) receptor antagonist and a weak SSRI with little effect on dopamine. It is classified as a serotonin receptor antagonist and reuptake inhibitor that reduces arousal and anxiety. At doses in the higher end of the reference range, trazodone can result in sedation or sleepiness.³¹ The SSRI effect can be enhanced at even higher doses. This effect can be beneficial for some dogs during a storm and has been used to facilitate postoperative confinement.³²

Trazodone should be given 1 to 2 hours before a noise event.^{32,33} To avoid gastrointestinal-related adverse effects, starting lower in the dose range and increasing to effect is recommended.

Antidepressants

Baseline medications (antidepressants) can be suitable for use as part of immediate treatment during storm season because they can help facilitate learning by helping to mitigate fear and anxiety (**TABLE 2**). This helps improve learning in the moment via classical conditioning and allows for a starting point for

TABLE 2 Common Behavioral Medications Used in the Treatment of Storm Phobia^a

DRUG CLASS	DRUG NAME AND FORMULATION	DOSAGE RECOMMENDATION	NOTES
BASELINE MEDICATIONS			
SSRI	Fluoxetine hydrochloride (Reconcile; Pegasus Laboratories, reconcile.com)	1–2 mg/kg PO q24h	Reconcile is FDA approved for treatment of canine separation anxiety in conjunction with a behavior modification plan.
SSRI	Sertraline	1–2 mg/kg PO q12h ²⁵	
TCA	Clomipramine hydrochloride (Clomicalm; Virbac, us.virbac.com)	1–3 mg/kg PO q12h ^{26,b}	Clomicalm is FDA approved for treatment of canine separation anxiety in conjunction with a behavior modification plan.
SITUATIONAL MEDICATIONS			
α ₂ Agonist	Clonidine	0.01–0.05 mg/kg PO given 1–2 h prior to storm and repeated PRN q6–8h	
α ₂ Agonist	Dexmedetomidine OTM gel (Sileo; Zoetis, zoetisus.com)	Administer onto the oral mucosa between the dog's cheek and gum at the dose of 125 µg/m ² 1 h prior to noise event or at the first sign of noise or fear. Can be redosed q2–3h PRN up to 5 times in 24 h.	Sileo is FDA approved for treating noise aversion in dogs. Use for storm aversion/phobia is off-label. Formulation is 0.1 mg dexmedetomidine/mL Sileo gel. Each dot represents 0.25 mL Sileo gel. Follow package insert for dot dosing using syringe system and body weight in pounds.
Anticonvulsant	Gabapentin	10–30 mg/kg PO given 1–2 h prior to storm and repeated PRN or q8–12h	
Anticonvulsant	Imepitoin (Pexion; Boehringer Ingelheim, nexion.co.uk)	10–30 mg/kg PO q12h, first dosed 2 days prior to anticipated noise event then q24h during storm season	Pexion is FDA approved for treating noise aversion in dogs but not distributed in the U.S. at the time of publication.
Benzodiazepine ^c	Alprazolam	0.02–0.1 mg/kg PO given 1 h prior to storm and repeated PRN q4–6h	Scored alprazolam tablets come in a variety of concentrations, making it easy to find a dose that works for most dogs.
Benzodiazepine ^c	Lorazepam	0.02–0.1 mg/kg PO given 1 h prior to storm and repeated PRN q8–24h	
SARI	Trazodone	3.5–10 mg/kg PO given 1–2 h prior to storm and repeated PRN q12h	

OTM = oral transmucosal; PRN = pro re nata (as needed); SARI = serotonin antagonist and reuptake inhibitor; SSRI = selective serotonin reuptake inhibitors; TCA = tricyclic antidepressant.

^aThe authors recommend that any medication given daily for 4 weeks or more be weaned to avoid any adverse effects from abrupt discontinuation.²⁵

^bClomicalm's labeled dose is 2 to 4 mg/kg PO q24h; however, many behavior clinicians find improved efficacy dosing this medication q12h.

^cThe benzodiazepines listed here are commonly used, but others could be appropriate.²⁷



response substitution during a storm. In this situation, they are most appropriate in geographic locations where storms occur frequently and unpredictably.

Long-Term Management: Nonstorm Season

Additional actions can be implemented during the nonstorm season. The following step numbers refer to the treatment steps in the preceding section.

STEP 3. Tool Implementation

Several websites and applications provide sound clips of storms. Ideally, a clip that most closely mimics the sound of storms in the home should be used for optimal DSCC success (see **STEP 4**). If possible, the owner can consider recording storms from inside their home during storm season and save them for playback during nonstorm season. Storm clip playbacks during DSCC may be more effective when using surround sound speakers placed near windows of the home.

STEP 4. Behavior Modification

During systematic desensitization, the dog is exposed to the fear-evoking stimulus in small gradients to allow habituation to occur. In dogs with storm phobia, this involves repeated exposure to the sound of storms, beginning at an almost imperceptible volume and gradually increasing to the actual level heard during a storm. Done correctly, this process could take weeks to months. Any unexpected storm at an intensity beyond what has been successfully worked on during training can cause the dog to regress, reinducing fear and panic. For this reason, DSCC must only be done in a controlled environment (i.e., in months when there is minimal chance of storms).

Systematic desensitization might not work for every dog with storm phobia, largely because it might not be possible to replicate all contextual cues the dog picks up on. Therefore, it is often combined with classical

and/or operant counterconditioning to speed the process (DSCC; **HANDOUT 3**). Classical counterconditioning can be added by pairing each clap of thunder in the recording with the immediate presentation of something pleasant. Response substitution can be combined with systematic desensitization by training the dog to perform relaxed or low-arousal behaviors, such as “settle,” and then cueing that behavior while playing the storm recording at the tolerated volume.²²

STEP 5: Pharmaceutical and Adjunct Treatments

Antidepressants can be helpful baseline additions for the long-term management of storm phobia when frequent and/or unpredictable triggers are anticipated (**TABLE 2**). These medications need to be given daily for a minimum of 4 to 6 weeks to reach therapeutic effect. When baseline medication for storm phobia is given outside of storm season, it is intended to augment immediate pharmaceutical treatment so that the behavioral response during the next storm season is not as severe and welfare is improved.

Baseline medications can also help improve the efficiency of DSCC progress outside of storm season for dogs that have generalized anxiety or comorbidities with storm phobia. Baseline medications might not be needed during off-season periods for dogs that have no behavioral comorbidities.

All the antidepressant medications listed below as baseline medication suggestions can have the common adverse effects of inappetence and lethargy during the first 1 to 2 weeks. However, these should be mild and resolve on their own. These effects can often be avoided by starting at the lower end of the dosing range. If adverse effects last more than 2 weeks or are severe, or other unwanted effects occur, the dose should be decreased or discontinued. Improvement in clinical signs of adverse effects should be noted within 48 to 72 hours after dose reduction if the medication is the cause. Otherwise, the dog should be evaluated for other unrelated causes of gastrointestinal upset, lethargy, or other new complaints.



HANDOUT 3

Follow this link for a client handout on systematic desensitization and counterconditioning for thunderstorms.

Selective Serotonin Reuptake Inhibitors

SSRIs inhibit serotonin transporters at the presynaptic ganglion, resulting in an increased amount of serotonin in the postsynaptic cleft, which then downregulates the



presynaptic inhibitory autoreceptors (5-HT_{1A}) after an extended period. Because of their specificity for serotonin receptors, SSRIs tend to have fewer adverse effects than other antidepressants.

Fluoxetine is the SSRI most used in dogs. Reconcile (Pegasus Laboratories, reconcile.com) is approved by the FDA for the treatment of separation anxiety in dogs in conjunction with a behavior modification plan, but it can be used off-label for storm phobia. Reconcile is considered to be more palatable to dogs than generic human formulations of fluoxetine (Prozac) because it is a beef-flavored chewable tablet. This formulation can be particularly helpful for storm phobia due to its ease of administration.

Sertraline, a generic form of Zoloft, has more dopaminergic activity than other SSRIs. Although not directly studied, in many clinicians' experience, sertraline might have fewer gastrointestinal adverse effects in dogs than fluoxetine. Because Sertraline's half-life is much shorter than that of fluoxetine in dogs, many clinicians report improved efficacy when it is dosed orally twice daily.³³

Tricyclic Antidepressants

TCAs have affinity for multiple receptors, including serotonin, norepinephrine, and histamine receptors. For this reason, TCAs may have more adverse effects than other antidepressants, including gastrointestinal upset, constipation, urinary retention, and sedation. However, these effects can be used to the clinician's advantage when treating a patient with comorbid conditions. For example, due to its antihistaminic and anticholinergic effects, clomipramine might be a helpful choice for a dog that is also pruritic or urinating frequently, respectively. TCAs should not be used in dogs with a history of glaucoma, diabetes mellitus, or urinary obstruction, or in male breeding dogs.

Clomicalm (clomipramine hydrochloride; Virbac, us.virbac.com) was the first FDA-licensed veterinary product to treat separation anxiety in dogs in conjunction with a behavior modification plan. Although FDA approval was given based on studies dosing it once daily, most experts see improved clinical response when administering it twice daily.³⁴ This veterinary formulation is also a meat-flavored chewable tablet, drastically improving palatability.

TCAs should not be used in dogs with a history of glaucoma, diabetes mellitus, or urinary obstruction, or in male breeding dogs.

Nonpharmaceutical Products

Several nutraceutical products are marketed for anxiety reduction in dogs. Although several studies report statistically significant results, most lack robust, clinically relevant improvements.³⁵⁻³⁹ In an analysis of data from 1225 respondents to an online survey, only 27% of owners who gave their dogs nutraceuticals reported that it alleviated their dog's noise fear.²³

Other nonpharmacologic tools, such as wearables and pheromones, also show equivocal effects. A systematic review of the efficacy of compression wraps as an anxiolytic tool in domesticated dogs found limited evidence to support the benefit of these devices.⁴⁰ However, when pressure vests are used as indicated, they are not associated with adverse effects.⁴⁰ Likewise, a systematic review of the use of pheromones for treating undesirable behavior in dogs yielded insufficient evidence to support the effectiveness of dog-appeasing pheromones for treating noise phobia.⁴¹ With a low risk of adverse effects, nonpharmaceuticals present minimal risk beyond the owner's financial investment, and veterinarians should be prepared to discuss such products with clients.

SUMMARY

Fear and anxiety in dogs with storm phobia leads to chronic stress and damages the human–animal bond. Due diligence should be followed in the problem-oriented approach to ensure that comorbid behavior diagnoses are not being mistaken for storm phobia as well as to rule out pain as an important contributing factor. Treatment should include fast-acting situational medications during storm season, safe spots, counterconditioning strategies, and in some cases, baseline antidepressant medication. Different combinations of medications may need to be trialed to reach optimum treatment outcomes. **TVP**

References

1. Siracusa C. Fears, phobias, and anxiety disorders. In: Landsberg G, ed. *Behavior Problems of the Dog and Cat*. 4th ed. Elsevier Health Sciences; 2023:467.
2. Ballantyne KC. Separation, confinement, or noises. *Vet Clin North Am Small Anim Pract*. 2018;48(3):367-386. doi:10.1016/j.cvsm.2017.12.005
3. Franzini De Souza CC, Maccariello CEM, Dias DPM, Almeida NADS, Medeiros MAD. Autonomic, endocrine and behavioural responses to thunder in laboratory and companion dogs. *Physiol Behav*. 2017;169:208-215. doi:10.1016/j.physbeh.2016.12.006
4. Byosiore SE, Chouinard PA, Howell TJ, Bennett PC. What do dogs (*Canis familiaris*) see? A review of vision in dogs and implications for cognition research. *Psychon Bull Rev*. 2018;25(5):1798-1813. doi:10.3758/s13423-017-1404-7
5. Riemer S. Therapy and prevention of noise fears in dogs—a review of the current evidence for practitioners. *Animals*. 2023;13(23):3664. doi:10.3390/ani13233664
6. Overall KL, Dunham AE, Frank D. Frequency of nonspecific clinical signs in dogs with separation anxiety, thunderstorm phobia, and noise phobia, alone or in combination. *JAVMA*. 2001;219(4):467-473. doi:10.2460/javma.2001.219.467
7. Tiira K, Sulkama S, Lohi H. Prevalence, comorbidity, and behavioral variation in canine anxiety. *J Vet Behav*. 2016;16:36-44. https://doi.org/10.1016/j.jveb.2016.06.008
8. Blackwell EJ, Bradshaw JWS, Casey RA. Fear responses to noises in domestic dogs: prevalence, risk factors and co-occurrence with other fear related behaviour. *Appl Anim Behav Sci*. 2013;145(1-2):15-25. doi:10.1016/j.applanim.2012.12.004
9. Salonen M, Sulkama S, Mikkola S, et al. Prevalence, comorbidity, and breed differences in canine anxiety in 13,700 Finnish pet dogs. *Sci Rep*. 2020;10(1):2962. doi:10.1038/s41598-020-59837-z
10. Riemer S. Not a one-way road—severity, progression and prevention of firework fears in dogs. *PLoS One*. 2019;14(9):e0218150. doi:10.1371/journal.pone.0218150
11. Lopes Fagundes AL, Hewison L, McPeake KJ, Zulch H, Mills DS. Noise sensitivities in dogs: an exploration of signs in dogs with and without musculoskeletal pain using qualitative content analysis. *Front Vet Sci*. 2018;5:17. doi:10.3389/fvets.2018.00017
12. Mills DS, Demontigny-Bédard I, Gruen M, et al. Pain and problem behavior in cats and dogs. *Animals*. 2020;10(2):318. doi:10.3390/ani10020318
13. Amadei E, Pierantoni L. Case report: noise and thunderstorm sensitivity in a dog with chronic pain. *J Vet Behav*. 2022;48:79. https://doi.org/10.1016/j.jveb.2021.06.010
14. Sherman BL, Mills DS. Canine anxieties and phobias: an update on separation anxiety and noise aversions. *Vet Clin North Am Small Anim Pract*. 2008;38(5):1081-1106. doi:10.1016/j.cvsm.2008.04.012
15. Dinwoodie IR, Dwyer B, Zottola V, Gleason D, Dodman NH. Demographics and comorbidity of behavior problems in dogs. *J Vet Behav*. 2019;32:62-71. https://doi.org/10.1016/j.jveb.2019.04.007
16. Meneses T, Robinson J, Rose J, Vernick J, Overall KL. Review of epidemiological, pathological, genetic, and epigenetic factors that may contribute to the development of separation anxiety in dogs. *JAVMA*. 2021;259(10):1118-1129. doi:10.2460/javma.20.08.0462
17. Bergman L, Gaskins L. Addressing any behavior problem. Clinician's Brief. Updated May 2013. Accessed May 7, 2025. https://www.cliniciansbrief.com/article/addressing-any-behavior-problem
18. Mills D, Dube MB, Zulch H. Sound sensitivity. In: Mills D, Dube MB, Zulch H, eds. *Stress and Pheromonotherapy in Small Animal Clinical Behaviour*. Wiley; 2012:191-214. doi:10.1002/9781118702642
19. Lindig AM, McGreevy PD, Crean AJ. Musical dogs: a review of the influence of auditory enrichment on canine health and behavior. *Animals*. 2020;10(1):127. doi:10.3390/ani10010127
20. Bowman A, Dowell FJ, Evans NP. The effect of different genres of music on the stress levels of kennelled dogs. *Physiol Behav*. 2017;171:207-215. doi:10.1016/j.physbeh.2017.01.024
21. Leeds J, Wagner S. *Through a Dog's Ear: Using Sound to Improve the Health & Behavior of Your Canine Companion*. Sounds True; 2008.
22. Haug L. Behavioral treatment techniques, behavior modification, and learning theory. In: Landsberg G, ed. *Behavior Problems of the Dog and Cat*. 4th ed. Elsevier Health Sciences; 2023:149-181.
23. Riemer S. Effectiveness of treatments for firework fears in dogs. *J Vet Behav*. 2020;37:61-70. https://doi.org/10.1016/j.jveb.2020.04.005
24. Merschel M. It's not just inspiration – careful breathing can help your health. American Heart Association. July 7, 2023. Accessed May 7, 2025. https://www.heart.org/en/news/2023/07/07/its-not-just-inspiration-careful-breathing-can-help-your-health
25. Landsberg G. M is for medication: pharmacotherapy for canine fear and aggression. Presented at: 44th World Small Animal Veterinary Association Congress; July 16-19, 2019; Toronto, Canada. Accessed May 7, 2025. https://www.vin.com/doc/?id=9382953
26. King JN, Simpson BS, Overall KL, et al. Treatment of separation anxiety in dogs with clomipramine: results from a prospective, randomized, double-blind, placebo-controlled, parallel-group, multicenter clinical trial. *Appl Anim Behav Sci*. 2000;67(4):255-275. doi:10.1016/S0168-1591(99)00127-6
27. Dantas LMS, Ogata N. Veterinary psychopharmacology. *Vet Clin North Am Small Anim Pract*. 2024;54(1):195-205. doi:10.1016/j.cvsm.2023.07.003
28. Gruen M, Case BC, Robertson JB, Campbell S, Korpivaara ME. Evaluation of repeated dosing of a dexmedetomidine oromucosal gel for treatment of noise aversion in dogs over a series of noise events. *Vet Rec*. 2020;187(12):489-489. doi:10.1136/vr.106046
29. Korpivaara M, Laapas K, Huhtinen M, Schöning B, Overall K. Dexmedetomidine oromucosal gel for noise-associated acute anxiety and fear in dogs—a randomised, double-blind, placebo-controlled clinical study. *Vet Rec*. 2017;180(14):356-356. doi:10.1136/vr.104045
30. Perdew I, Emke C, Johnson B, et al. Evaluation of Pexion® (imepitoin) for treatment of storm anxiety in dogs: A randomised, double-blind, placebo-controlled trial. *Vet Rec*. 2021;188(9):e18. doi:10.1002/vetr.18

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31. Papich MG. Trazodone hydrochloride. In: *Papich Handbook of Veterinary Drugs*. 5th ed. Elsevier; 2021:926-929. <https://doi.org/10.1016/B978-0-323-70957-6.00546-X>
32. Gruen ME, Roe SC, Griffith E, Hamilton A, Sherman BL. Use of trazodone to facilitate postsurgical confinement in dogs. *JAVMA*. 2014;245(3):296-301. doi:10.2460/javma.245.3.296
33. Gruen ME, Sherman BL. Animal behavior case of the month. *JAVMA*. 2012;241(10):1293-1295. doi:10.2460/javma.241.10.1293
34. Landsberg G. Appendix B. Medication dosages. In: *Behavior Problems of the Dog and Cat*. 4th ed. Elsevier; 2024:532.
35. Landsberg G, Huggins S, Fish J, Milgram NW. The effects of a nutritional supplement (Solliquin) in reducing fear and anxiety in a laboratory model of thunder induced fear and anxiety. Presented at: 11th International Veterinary Behaviour Meeting; September 14-16, 2017; Samorin, Slovakia. Accessed May 7, 2025. <https://doi.org/10.1079/9781786394583.0094>
36. Pike AL, Horwitz DF, Lobprise H. An open-label prospective study of the use of L-theanine (Anxitane) in storm-sensitive client-owned dogs. *J Vet Behav*. 2015;10(4):324-331. <https://doi.org/10.1016/j.jveb.2015.04.001>
37. DePorter TL, Landsberg GM, Araujo JA, Ethier JL, Bledsoe DL. Harmonease Chewable Tablets reduces noise-induced fear and anxiety in a laboratory canine thunderstorm simulation: a blinded and placebo-controlled study. *J Vet Behav*. 2012;7(4):225-232. <https://doi.org/10.1016/j.jveb.2011.05.024>
38. Orlando JM. Behavioral nutraceuticals and diets. *Vet Clin North Am Small Anim Pract*. 2018;48(3):473-495. doi:10.1016/j.cvsm.2017.12.012
39. Overall KL. Pharmacotherapeutics in clinical ethology: treatment efficacy, clinical pathology and outcome. *Behaviour*. 2021;158(14-15):1355-1419. <https://doi.org/10.1163/1568539X-bja10096>
40. Mathis S, Schoolfield S, Gross P, Gruen M, Dorman DC. A systematic review of the efficacy of compression wraps as an anxiolytic in domesticated dogs. *Animals*. 2024;14(23):3445. doi:10.3390/ani14233445
41. Frank D, Beauchamp G, Palestini C. Systematic review of the use of pheromones for treatment of undesirable behavior in cats and dogs. *JAVMA*. 2010;236(12):1308-1316. doi:10.2460/javma.236.12.1308

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Storm Phobia in Dogs



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CE QUIZ QUESTIONS

1. **A systematic problem-oriented exam approach helps identify all the following except:**
 - a. Orthopedic pain
 - b. Underlying neurologic or endocrine conditions
 - c. Signs of other behavioral comorbidities
 - d. The genetic component of storm phobia
2. **Which of the following can help discern if a dog with storm phobia also has separation anxiety?**
 - a. Playing a loud audio clip of thunder to see the dog's reaction
 - b. Reviewing a video recording of the dog when it is home alone
 - c. Assessing the level of property destruction during a storm
 - d. Determining that trembling and whining are only present during storms
3. **All dogs with storm phobia have noise phobia.**
 - a. True
 - b. False
4. **Which of the following is true of dogs with storm phobia?**
 - a. Fear responses are seen with all loud noises.
 - b. Fear responses always stop immediately after the storm is over.
 - c. Fear responses can start with contextual cues of impending storms.
 - d. Fear responses will always diminish the more the dog is exposed to storms.
5. **Which medication is FDA-approved for noise aversion in dogs but can be used off-label for storm phobia?**
 - a. Fluoxetine (Reconcile)
 - b. Dexmedetomidine (Sileo)
 - c. Clomipramine (Clomicalm)
 - d. Sertraline (Zoloft)