Noise-related fear in dogs

This comprehensive guide delves into the phenomenon of noise-related fear in dogs, a prevalent issue with a significant impact on canine wellbeing. The article explores the intricate relationship between a dog's emotional response to noise and its behavioural expressions, highlighting the complexity of noise-related fear, its clinical manifestations and therapeutic approaches. It emphasises the importance of differentiating fear from anxiety and phobias, as they exhibit distinct characteristics that necessitate separate consideration in both diagnostic and therapeutic contexts. The guide explains how various factors can contribute to the development and progression of noise-related fear in dogs, including genetic predispositions, breed-specific traits and traumatic events related to noise exposure. It also addresses the critical role of veterinary professionals in managing noise-related fear, advocating for informed, proactive approaches in prevention, management and treatment. The guide stresses the importance of early detection and intervention, tailored treatment strategies, and the collaborative involvement of pet owners. Overall, it offers a holistic approach to safeguard the development of noise-related fear in dogs, aimed at improving their behavioural response and overall quality of life.

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Noise-related fears are a prevalent problem in dogs and were the highest reported anxiety-related trait in a recent owner survey (Salonen et al, 2020). They reportedly affect up to half of the population of pet dogs (Blackwell et al, 2013; Storengen and Lingaas, 2015; Tiira et al, 2016); however, only a small proportion of these owners seek professional advice to help their pets (Dale et al, 2010; Blackwell et al, 2013; Tiira et al, 2016). For many pet owners, concern relating to noise fears may be centred around specific times of year such as bonfire night and New Year's Eve, as well as other celebrated holidays such as Diwali which are associated with fireworks (*Figure 1*). Fireworks are often reported within the literature as being the most common triggers for noise fear in dogs alongside fear of gunshots and thunderstorms (Overall et al, 2016). However, this perspective fails to recognise the plethora of other sounds which can contribute to noise fear and the relative ease with which these fears may generalise to a wider spectrum of noise events.

In the complex world of domestic dogs, certain external stimuli – particularly loud and sudden noises like fireworks or thunder – play a pivotal role in eliciting emotional responses. These auditory triggers, often intense and unpredictable, transcend mere background events in a dog's life; they can significantly influence a dog's psychological state, eliciting strong reactions rooted in the primal emotion of fear (Blackwell et al, 2013). This article provides a comprehensive guide on noise-related fear responses in dogs, with a focus on behavioural reactions when exposed to such auditory stimuli. Understanding these responses is crucial, as it not only informs better pet care and training practices, but also aids in developing strategies to enhance the wellbeing and quality of life of dogs. A thorough understanding of the fundamental and essential concepts of emotions and fear in dogs is essential. Delving into these core principles lays the groundwork for interpretation and effective management of the complex phenomenon of noise-related fear in dogs.

What are emotions and what is fear?

Emotions are relatively short-term affective states typically occurring in situations involving (potential) rewards or punishers (Rolls, 2005). They are complex phenomena and are accompanied by changes in a range of different so called 'emotion components'. The behavioural component refers to observable modifications in an animal's actions or reactions when experiencing an emotion (Mendl et al, 2010). The physiological component encompasses the internal physical changes that occur, such as an increased heart rate or changes in hormone levels, contributing to the arousal level during emotional states. The subjective component involves the personal, internal experiences of the emotion – feelings. Emotions also encompass a cognitive (appraisal) component, influencing actions and shaping decision-making processes, thus guiding an individual's responses to environmental stimuli (Mendl and Paul, 2020).

Fear is a basic emotion that plays vital adaptive functions by promoting survival prospects in the face of danger (Panksepp, 2004). Hence, fear is triggered by threats that may inflict harm or compromise an organism's physical integrity, prompting an immediate and appropriate response. Therefore, fear is generally a normal response required for self-protection, enabling escape from

Emergency management and first aid advice for dog owners regarding festive season fireworks

Understanding noise-related fears in dogs

- Fireworks commonly used during festive celebrations can trigger intense noise fears and stress in dogs.
- **Potential for new fears:** Even dogs without a prior history of noise fear can develop it from a single traumatic event.
- **Precaution is key:** Owners should be cautious and consider preparatory actions for all dogs, regardless of their past reactions to loud noises. Proactive management can prevent the development of long-term noise fears.

Pre-firework preparations

- **Early walks:** Take the dog out for a walk earlier in the day when there's less likelihood of fireworks.
- **Create a safe haven:** Set up a quiet, comfortable space for the dog, away from loud noises.
- **Practice desensitisation:** Gradually expose the dog to recorded firework sounds to reduce sensitivity.
- **Long-term training:** If noise fear is known or if the dog was stressed by fireworks last year, start desensitisation training months in advance, as this process takes time.
- **Consult a vet:** Discuss medication or supplements for fear with a veterinarian.

During fireworks management

- **Presence is essential:** Never leave the dog alone during fireworks; be there to provide comfort and reassurance.
- **Distract and engage:** Use toys, treats, or games to distract the dog from the noise.
- **Minimise external noise:** Shut windows to reduce the sound and turn on music or the TV to provide familiar auditory comfort.
- **Respect the dog's space:** Allow the dog to find their own safe spot and avoid forcing interaction, which can increase stress.

Post-fireworks care

- **Monitor behaviour:** Watch for any remaining signs of stress or fear after the event.
- **Gradual return to routine:** Slowly reintroduce the dog to regular activities once the noise subsides.
- **Evaluate and adjust:** Observe the dog's responses for better planning in future events.
- **Behavioural consultation:** If the dog showed severe or persistent stress or even noise-related fear, consider asking a vet for referral to a veterinary specialist in behavioural medicine.

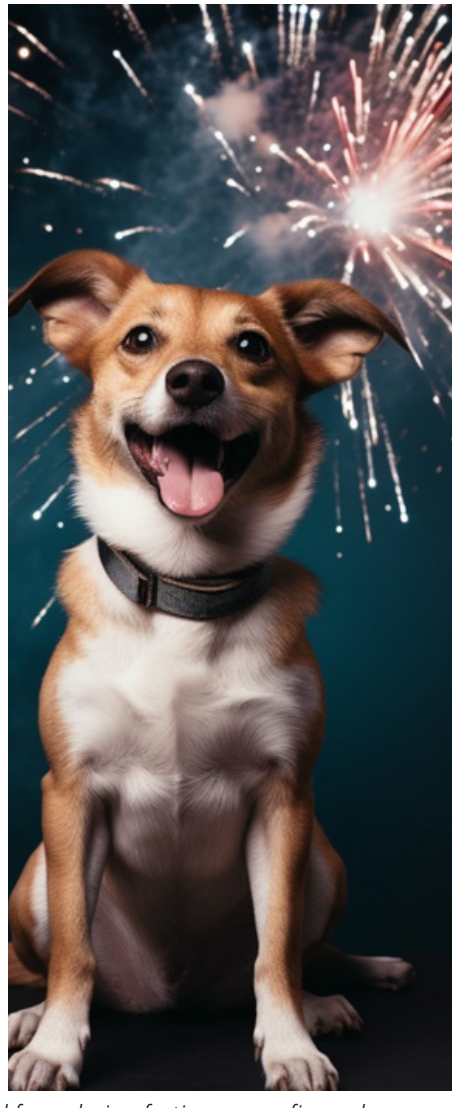

Figure 1. Preparation and understanding the dog's needs are key to managing noise-related fears during festive season fireworks.

(potentially) dangerous situations (Storengen and Lingaas, 2015). The 'fight or flight' response is central to this emotion, involving a series of reactions that prepare an organism for confrontation or evasion when faced with imminent threats. While 'flight' is often chosen in face of avoidable threats (Panksepp, 2004), 'fight' is more probable when escape is not an option. 'Freezing', characterised by static immobility, is another typical behavioural tendency for fear, often occurring when the threat seems distant (Panksepp, 2004). The accompanying physiological responses that prepare the body for such actions include an increased heart rate, blood redirection to essential muscles and adrenaline release, thus laying a physical foundation for the confrontation with or evasion from dangers.

It is crucial to differentiate fear from anxiety and phobias. These states, while inter-related and often present with overlapping symptoms, exhibit distinct characteristics that necessitate separate consideration in both diagnostic and therapeutic contexts.

Differentiating fear from anxiety and phobias

Fear is distinct from anxiety and phobias, although they are often conflated (Sherman and Mills, 2008; Storengen and Lingaas, 2015). Fear manifests as an acute and immediate alarm response to an actual, real threat, causing an individual to confront or flee – rapidly withdraw – from the danger (Sherman and Mills, 2008). This response is beneficial in real-time situations where harm is imminent, facilitating self-protection.

Anxiety is a more prolonged and less specific state that lacks a concrete eliciting stimulus (Riemer, 2019). It is typically not a reaction that necessarily stems from an immediate threat, and thus it is not associated with a specific stimulus, but is characterised by the anticipation of potential future dangers or negative outcomes (Sherman and Mills, 2008; Storengen and Lingaas, 2015). Anxiety, leading to a diffuse sense of unease, can persist well beyond the

presence of a direct threat, often triggered by ambiguous or undefined stimuli and manifesting as a state of heightened alertness.

Phobias represent a form of anxiety disorder; they are irrational and extreme/excessive responses related to specific stimuli – objects, subjects or situations (Sherman and Mills, 2008). Phobias provoke a response that is disproportionate to the potential threat posed by the feared stimulus; not merely intense fear but also including persistent avoidance behaviours and severe distress that disrupt normal functioning.

The specifics of noise-related fear

A considerable proportion of pet dogs display behavioural problems linked to fear, with noise-related fears being particularly prevalent (Gähwiler et al, 2020). Fear responses to noises are also termed as noise fear, noise sensitivity, noise reactivity, noise aversion or noise stress (Riemer, 2019). Noise-related fear can occur in response to many different types of sudden and loud noises, including fireworks, thunderstorms, gunshots and sounds of engines (Storengen and Lingaas, 2015). The loud, unpredictable, unexpected and intrusive nature of these sounds can provoke a dog's acute emotional response, including a set of physiological changes. A resulting adrenaline rush or an increase in heart rate, which signifies a state of heightened arousal, prepares the dog for immediate action in response to a threatening stimulus. Such triggering noises are often atypical in a dog's environment, likely making them particularly alarming. For dogs, their sensitivity to noise is compounded by their sensitive auditory system, which can make these sounds seem aversive and potentially exceed the auditory pain threshold (Levine, 2009). Dogs' reactions to loud, sudden noises may originate from the natural aversion to potential danger signals, reminiscent of their wild ancestors' need for survival in environments where such noises might indicate approaching threats.

Various risk factors have been linked to the development and progression of noise-related fear in dogs, including (Storengen and Lingaas, 2015):

- Genetic predispositions
- Breed-specific traits
- Social emotion transmission and learning (dogs may experience fear from perceiving other fearful individuals possibly through the mechanism of emotional contagion)
- Owner reactions (such as reinforcing the dog's fear or responding inappropriately)
- Gender (female dogs appear more prone to develop noise fear than male dogs)
- Age.

A particularly sensitive period in the development of dogs, typically occurring between 3 and 14 weeks of age, can also play a crucial role in shaping a dog's responses to noises and their environment. During this critical window, puppies are highly receptive to new experiences. Lack of exposure, or negative experiences with loud or sudden noises during this period, is likely to increase the risk of developing noise-related fears.

Interestingly, there seem to be associations between the occurrence of noise-related fear and separation-related problems in dogs (Storengen and Lingaas, 2015). However, traumatic events related to noise exposure can also lead to the emergence of noise-related fear in dogs (Storengen and Lingaas, 2015). Even a dog with no previous signs of noise fear can be triggered by a single unexpected, loud event, potentially resulting in a lasting fear response. Such an intense noise event can imprint a fear memory within the canine brain, potentially leading to enduring behavioural changes. Such a reaction, though adaptive in preparing the animal for future threats, can become maladaptive in non-threatening but loud domestic contexts.

Recognising behaviours associated with noise-related fear in dogs

Observing the behaviour of dogs can offer valuable insights into their emotional states, including fear responses to noise. It is thereby crucial to acknowledge that behaviour can be viewed at different levels, encompassing holistic action tendencies to very nuanced communicative facial and body expressions (Mills, 2017). For instance, a common holistic behavioural tendency displayed by dogs during (noise-related) fear includes avoidance behaviours, such as fleeing from or attempting to escape the noise source. Alternatively, dogs may exhibit freezing – a static response often characterised by a dog remaining still in a steady posture, with a rigid body, ears pulled back and widely opened eyes. Hiding is another behaviour frequently associated with noise-related fear (Gähwiler et al, 2020), where dogs seek refuge in perceived safe spaces away from the source of their fear. Moreover, in fear states, increased activity levels, manifesting as general restlessness, locomotion, pacing, shaking, trembling, startle responses and heightened vigilance, are often observed (Mills, 2005; Gähwiler et al, 2020). Additionally, dogs might seek comfort and security through clingy behaviour or seeking closeness to their owner.

Subtle signs of noise-related fear include flattened ears, panting, excessive blinking (though the latter may vary greatly among individuals), dilated pupils, excessive licking and vocalisations (Mills, 2005; Gähwiler et al, 2020). These facial and body expressions, with the ladder including a lowered body posture or a tucked tail, provide critical information about a dog's fear state. Recognising these behaviours as manifestations of fear is essential for owners, as well as veterinarians, veterinary staff, and other dog professionals, to provide suitable support and intervention.

However, it is generally important to consider that behaviours linked to fear in dogs may not be uniquely tied to this emotion alone, as similar expressions can be associated with a variety of other (emotional) states. Thus, in order to accurately infer a canine emotion, a thorough and comprehensive approach, incorporating information from multiple sources, is essential. This includes incorporating the situational context (in the case of noise-related fear, the presence of a triggering sound), the dog's arousal state, motivation (the goal of the exhibited behaviour, e.g. to withdraw from a threatening sound), and the observable (communicative) behavioural expressions (Mills, 2017). Moreover, although at least some degree of consistent responses during noise-related fear across dogs can be expected, it is essential to acknowledge that the behaviours expressed by individuals when experiencing this state may at least partially vary from one dog to another, influenced by factors such as genetics, the dog's temperament, socialisation, past experiences, with similar stimuli or their natural coping mechanisms.

Understanding an individual dog's specific response to fear-inducing stimuli is vital for developing a tailored approach to help them coping in such challenging situations. For instance, dogs displaying behaviours such as fleeing or pacing might benefit from a designated 'safe haven' or engaging in physical activities that safely divert their attention from the noise. Conversely, dogs exhibiting more passive behaviours like freezing or hiding may respond more positively to gentle reassurance, offering treats, or calm play in a soothing environment. These tailored strategies underscore the need for a nuanced understanding of each dog's specific reactions to fear-inducing stimuli, allowing for more effective and supportive interventions. To sum up, recognising the presence of noise-related fear in dogs is the foundational step towards developing an effective treatment strategy, which involves tailoring interventions to meet the individual needs of each dog. The following sections will present further effective strategies for this purpose.

Clinical manifestations of noise-related fear

While fireworks are considered one of the most important sounds triggering noise-related fear in dogs (Overall et al, 2016), it is important to understand that this fear reaction can easily generalise to other types of sounds. However, the literature is sparse when considering generalisation of noise-related fears; it is documented that other behaviours such as generalised or other specific fears and agonistic responses are seen to increase over time (Riemer et al, 2016). Studies undertaken to assess the ontogeny of noise-related fears have indicated that, while a small number of dogs appear to spontaneously recover from noise-related fear (often associated with hearing loss), for many animals the fear increases over time and is positively associated with increasing age (Dale et al, 2010; Overall et al, 2016). As a result, it is important that owners are helped to recognise the behavioural and physiological signs of anxiety and fear in their animals so that early intervention, such as referral to an accredited Clinical Animal or Veterinary Behaviourist, can be made, thereby lessening the likelihood of further generalisation of an established noise fear to other similar sounds or associated places within the environment. Generalisation of noise fears is common because of the similarities in the characteristics of noises commonly associated with fear responses such as the sounds reaching high decibels, lacking a pattern and may not feature significant levels of ultrasound characteristics or other cues as to the localisation of the sound to allow the dog to orientate usefully to it (Levine, 2009).

Noise-related fears have significant impacts on both the physical and emotional health of the patient. This is especially true as these fears generalise to a wider variety of noise events whereby the pervasiveness of the fear response may become a significant welfare issue. Intensification of noise-related fear also increases the emotional and physiological cost to the animal when the increased fear response heightens behavioural responses from more subtle signs such as lip-licking, yawning and stance alterations through passive signals such as freezing, panting, hiding, cowering and trembling and more active responses such as attention seeking, hypervigilance, pacing, vocalisation, stress-related elimination and escape attempts, and elevates (chronically or acutely) the bodily stress response (Levine, 2009; Lopes Fagundes et al, 2018).

Within the stress response, glucocorticoids are significant as when they are too low or too high memory and learning are likely to be impaired (Notari, 2009). Stressful events are often well remembered by dogs, with stimuli being associated with very few, even just one, exposure to the stressor. With reference to noise fears, associative learning often occurs in relation to the various elements of the collage of stimuli related to these events such as olfactory cues, visual cues, locational information and so forth which may mean that the fear responses may be generalised to other situations where aspects of the stimulus collage are identified again (Levine, 2009). Conversely, stressful experiences may also impair recollection of events, including positive experiences, which is especially prevalent during intensely stressful experiences where behavioural responses are often emotionally dominated.

Emotional health and wellbeing

The canine brain is a heterarchical, complex system with varied bidirectional information exchange and processing that is dynamic and evolves over time through experiential learning. Recurrent network pathways enable holistic processing of sensory external and somatic information which is important for survival through a distributed architecture. However, at times of stress, this can lead to suppression of some activities and enhancement of others (Pessoa, 2022). The amygdala, which is stimulated within the auditory pathway (through parallel processing from the sensory thalamus to both the amygdala and the auditory cortex), is also stimulated in fear, stress and anxiety responses. This stimulation, alongside other bodily stress-induced responses, can lead to the development of noise-related fear in dogs (Notari, 2009).

When dogs hear an auditory stimulus, their neural system registers it against a host of expectations generated from past experiences. There occurs a matching process between input information and feedback from previously established 'template signals' (systems of prediction of input updated over time to reflect the animals' history) leading to behavioural, emotional and physiological responses (Pessoa, 2022). Where animals have not had the opportunity to habituate (gradually get used to an increasing range and intensity of sounds), or are exposed to novel or intense stimuli that they have no mental 'template' for, a stress response may ensue.

Physiological health and wellbeing

Animals with noise-related fears may suffer stress at different stages: acute stress (single intense challenge), which may be instrumental in immediate (one-trial) learning; chronic intermittent stress (repeated exposure over prolonged time periods, such as annual firework periods); or chronic stress (long term exposure to stress) such as generalised noise-related fear where the animal develops fear of a wide range of sounds within the everyday environment. Chronic stress, where the animal is exposed to sustained and repeated aversive stimuli over time may lead to dysregulation of the hypothalamic–pituitary–adrenal axis, which can lead to effects across different brain areas as a result of excess corticosteroid exposure, leading to impaired learning and memory. In addition,

there may be repercussive effects on the general health status of the animal, such as a higher heart rate, sympathetic predominance, higher haematocrit levels and higher levels of plasma cortisol, progesterone, vasopressin and beta-endorphins (Notari, 2009; Franzini de Souza et al, 2018).

Chronic exposure to stressors can lead to immunological changes through corticotrophin-mediated suppression of cell growth, proliferation and differentiation, as well as other immune cell modifications. The effects on the immune system may also alter the regulation of T-helper cells, reducing the body's ability to block and destroy pathogens (Notari, 2009). In addition, both acute and chronic stress have implications for the gastrointestinal system, with sympathetic activation during acute stress often leading to vomiting, diarrhoea and excessive salivation. In chronic stress, gastric acid secretion increases while blood flow to the gut and protective gut mucus secretion decreases, leading to increased risk of damage to the gastric surfaces with impaired healing evident because of long-term inhibition of prostaglandin synthesis as a result of elevated corticosteroid levels (Notari, 2009).

Pain is often a significant factor in behavioural problems, either as a direct cause of the manifestation, underpinning secondary concerns within a behavioural problem or exacerbating behavioural problems. Mills et al (2020) reported that pain may be a contributory factor to behavioural problems in 28–82% of cases. Within noise fears, it has been demonstrated that dogs with pain showed widespread generalisation of noise-related fears to associated environments when compared to control cases without pain. These cases generally respond well to behavioural treatment once pain is controlled (Lopes Fagundes et al, 2018). In addition to pain, other medical conditions can be associated with the development of noise-related fears such as cognitive dysfunction (Landsberg et al, 2011), hypothyroidism (Aronson and Dodds, 2005) and iatrogenic corticosteroid administration. These should also be considered as causative or contributing factors when dealing with dogs presenting with noise fears.

Prevention and treatment of noise-related fears in dogs

Prevention

While there is still not a complete picture regarding the acquisition and development of noise-related fears in dogs, there are some general considerations that are useful in aiming to avoid their development:

- Genetics: prospective owners should ascertain whether noise fear is an issue seen in the dam, sire or previous offspring of either parent.
- Neutering: avoiding early-age gonadectomy is advisable unless indicated for health reasons (Mills, 2005; Houlihan, 2017).
- Habituation: owners and breeders should be advised to habituate their puppies gradually to a wide variety of noises from an early age. Ideally, this should begin in the neonatal stage when the puppy is still with the dam and should continue throughout the first few months of life. It is often useful to revisit habituation processes during the second sensitive phase of development (which varies within individuals but is generally observed between the age of 6 and 14 months) when adolescent dogs may show some regression of prior habituation. Ideally, habituation should occur in a live setting where the puppy can associate the noise with the other sensory aspects of the stimulus (for example, see and hear a car) and where the sounds are paired with positive things such as treats and playing games. Sound recordings can be used – these are especially useful when live access to particular sounds (such as fireworks, gunshots and air brakes) may not be readily available. However, these do not allow puppies to associate the noise with a contextual stimulus, which may lead to lower efficacy over real-life sound habituation. During habituation, a variety of common sounds should be introduced, starting at a very low level of intensity (low volume and/or at a distance) and gradually increasing in intensity over time, providing that there is evidence of habituation (the puppy pays less and less attention to the noise as it becomes part of their normal environment) at the previous stage. If this process is rushed, or the puppy is exposed to a frightening noise before they are habituated, this may lead to sensitisation (the opposite of habituation) where the puppy finds the noise more salient and pays more attention to it over time.
- Avoid flooding: it is important that owners understand that presenting their puppies with intense exposures and/or for extended periods of time (for example taking a puppy to a firework display) or in combination with many other stimuli simultaneously can lead to flooding and the subsequent development of aversions to the stimuli experienced. Flooding initiates a stress response which can lead to increased fear and consequent freeze, flight or fight behaviours (Landsberg, 2022). During flooding, an animal is exposed to the stimulus at a high intensity until they are seen to cease responding to it. This process is far more stressful than other available options such as careful habituation or desensitisation.
- Report noise-related fears early: encouraging owners to report early signs of noise fear leads to a better prognosis and avoids further development and/or generalisation of the fear. Owners may underestimate the effects of noise-related fears until they escalate to unmanageable levels (Grigg et al, 2021). Early signs of noise-related fear in dogs may include subtle changes in posturing, such as the ears flattening or rotating backwards, a tense muzzle, increased lip licking, lowered or tucked tail position and slight cowering in response to sound. The owner may also notice increased 'clinginess' towards them, hesitation when entering specific places or areas, increased vigilance and arousal to sounds and a reduction in the ability to settle amidst sounds.
- Preparation: owners should be advised on how they may adapt the environment to prepare for anticipated noise events to ensure that their animals are not flooded with stimuli (*Figure 1*). Preparations such as providing a safe haven for their animal to settle in well ahead of time, playing background music to mask sudden and loud sounds and blocking out aspects of the stimulus collage by closing blinds/curtains, as well as using rooms furthest away from the sound are some considerations that can help to avoid fear responses developing (Ballantyne, 2023).
- The safe haven: a safe haven should be a comfortable, cosy and den-like sanctuary for the dog. Safe havens should be set up in

an area of the home that is most sound insulated, not isolated from family but also not in a thoroughfare where the animal will be continually disturbed. Safe havens should be well covered to make them dark, contain plenty of bedding material (including blankets and duvets that the animal may wish to bury into during noise events), be always accessible to the animal and be a haven where they will not be disturbed nor forced out of. The dog should never be forced to enter the safe haven, instead they should be habituated gradually and encouraged to explore their safe haven through regular (several times daily, initially) sprinkling of treats in the area. They should not be enclosed within the area until this has been gradually introduced and the dog is comfortable at each stage. Some dogs in a distressed state (such as during noise events) may panic if they feel trapped in an area; therefore, they must be given choice and agency regarding entering or exiting the safe haven area. Some dogs find restriction in a small area distressing and in these cases, it can be helpful to set up a pen area around the crate to gradually habituate them to restriction and confinement at a lower intensity. Placing important resources such as food, water and toys in the pen area can help to engender positive associations with the safe haven area.

- Owner behaviour: reassuring a fearful animal can help them realise that the sound is safe, providing that the owners' response is calm, positive and consistent. Owners should remain focussed on remaining upbeat and on engaging the animal in another activity to teach them coping strategies for these events (Ballantyne, 2023). Owners should be advised to be aware of their body language and vocal cues during such episodes (Mills, 2005).

Treatment

There are a range of treatment modalities that may be used to improve canine responses to noises. The treatment modalities selected should be based on the individual case and must always consider the clinical history of the animal. Treatment options may often be combined to create a holistic behaviour modification plan, with the addition of psychopharmacy to aid progress and enhance welfare in some cases. Initially, it is important to address any physiological components relating to the initiation and maintenance of the issue whilst considering any predisposing factors that may be relevant to the individual, such as genetic influences (Lopes Fagundes et al, 2018). Likewise, many dogs with noise-related fears may have other behavioural comorbidities such as separation-related issues or generalised anxiety, and these responses must be considered within a holistic behaviour modification plan (Ballantyne, 2023).

Desensitisation and counter-conditioning

Desensitisation and counter-conditioning is the process of a gradual and incremental exposure to stimuli (eg sound) while pairing these stimuli with rewards (treats, toys, games). While it is theoretically advantageous to undertake desensitisation and counter-conditioning, a real-world context that allows the animal to associate the noise with the ability to orientate to the stimulus producing it (over 70% of owners reported improvements using this method; Riemer, 2020), brings with it a number of challenges. These include the inability to control the intensity of the noise and the potential for further trigger stacking (the repetition of short-lived, separate aversive experiences which occur in clusters with the dog unable to recover fully before the next exposure) and generalisation because of the presence of unrelated (but easily associated) stimuli in the immediate vicinity. Therefore, noise recordings are often used within the desensitisation and counter-conditioning process so that they can be introduced in a safe environment that the animal is relaxed in. The use of recordings allows for gradual and incremental exposure and pairing the sounds with rewards to condition positive emotional responses to the previously negatively associated sounds (Levine, 2009). This process has been demonstrated to be effective via owner self-report with around 55% of owners reporting improvements (Riemer, 2020). For some animals, desensitisation to general noise recordings may not transfer to real-life noises. For these animals, it can be useful for the owner to record the actual noise(s) that the animal is fearful of (rather than using stock sounds) as this may be more salient for the dog. Often, playing the sounds in a variety of locations can help to contextualise the recorded sounds for the dog providing that they are comfortable with hearing the sounds in the safe home environment first – for example playing firework sounds from outside of the house while the dog is inside with an owner or playing gunshot recordings on a walk. Other contextualisation such as playing firework noises at night or playing air brake noises while walking down the road can provide useful information to the dog and increase the efficacy of this behaviour modification technique.

In all situations where these techniques are used, the animal should remain relaxed in their body posture and should not be showing any of the aforementioned subtle signs of distress. They should indicate their hearing of the sound through changes in ear position and their attention orienting calmly towards the sound. If the owner sees signs of fear such as tense muscle tone, ears back, lip licking, yawning, cowering, tail tucking, clinginess, avoidance behaviours and attention seeking, even at a very low level, they should take a break and reduce the intensity of the stimulus for a number of repetitions when they resume training. Progression should be gradual with very small increases in intensity at each stage. Each increase in stimulus intensity should be repeated a number of times with the animal displaying relaxed responses at each repetition before increasing intensity further. Each new training session should begin one step back from the end of the previous session in order to acclimate the animal and set them up to succeed. For example, if a dog finished their previous training session at noise level eight, the owner should begin the next session at noise level 7, briefly, before progressing forwards.

It is often useful to undertake desensitisation and counter-conditioning to a range of sounds including the fear-inducing stimuli and other sounds that are similar in their properties, such as sudden, percussive sounds. For some dogs, there may be a wide range of sounds in daily life which evoke low-level fear responses that may easily go unnoticed by caregivers. As such, it can be useful to proactively undertake desensitisation and counter-conditioning to these general environmental sounds within the programme in order to reduce the potential impact of trigger stacking of sounds, leading to higher

baseline stress levels and lower coping threshold for the more salient sounds which initiate more overt fear responses (Ballantyne, 2023).

Dog-appeasing pheromone

The dog-appeasing pheromone provides a chemical cue of safety that can enhance calmness. The products may be used as sprays, collars or diffusers depending on the context (Levine, 2009). The use of dog-appeasing pheromone has been studied in relation to the treatment of noise-related fear alongside desensitisation and counter-conditioning. Levine and Mills (2008) identified that the addition of dog-appeasing pheromone to the desensitisation and counter-conditioning process maintained improvements in fear responses to noises for a year after treatment compared with treatment groups without dog-appeasing pheromone use, whose responses improved for 1–2 months during treatment.

Environmental adaptations

Providing animals with their own safe haven where they can learn to relax and rest can be beneficial during times of sound exposure. Safe havens should be available to the animal all the time, and their use should be regularly reinforced. Consideration of the placement of safe havens is important in sound fears; they should ideally be placed away from windows and doors in a more sheltered part of the home that is not a thoroughfare, but where the animal will also easily have company for reassurance during noise events. Making safe havens cosy (lots of bedding to facilitate burrowing) and covered with a thick blanket or crate cover helps to increase the feeling of safety and further muffles sounds (Mills, 2005; Ballantyne, 2023). For dogs who are sensitive to atmospheric pressure, some authors recommend the use of storm defenders (thin metal sheets within soft covers) to repel ionic charges (Cottam and Dodman, 2009). Some dogs will tolerate the use of ear plugs or defenders (with prior habituation and reinforcement of their use) and these may help those individuals to cope with sound events.

Teaching a dog how to relax and settle more generally is also suggested to be beneficial during noise events with relaxation training reported to be efficacious in aiding calmer responses to sounds by 69% of dog owners (Riemer, 2020).

The use of white noise (from equipment such as fans or from an app) can be beneficial for some dogs, as can playing relaxing music (such as classical music (Wells et al, 2002) and slow tempo simple arrangements (Leeds and Wagner, 2008)) and blocking out any visual triggers related to the noise fear. Owners should take care that these noises used to mask fear inducing noises do not become conditioned themselves to produce a negative emotional response in the dog as a result of their pairing with aversive events. It can be useful to play these 'masking' noises at times other than when there are aversive events occurring, such as during play, when engaging in interactive food enrichment or when relaxing at home to create positive emotional responses to the noises, which may be protective against negative association formation and also helpful in reducing fear during an aversive event.

Adjunct therapies

There are many purported ancillary therapies on the market for helping dogs with generalised and noise-specific fears; however, there is limited evidence for the efficacy of many of these products. A study by Riemer (2020) identified that the most efficacious owner-reported intervention was the use of prescription medication, with 69% of owners reporting improved behavioural responses to noises when using a prescribed medication for their dog. In this study, pheromone and nutraceutical adjuncts were reported to show improvements in the range of just 27–35% overall. However, some evidence has suggested that supplementation with alpha-casozepine, *Piper methysticum* or L-tryptophan-based products can be helpful in some cases (Beata et al, 2007; Palestrini et al, 2010; Earon et al, 2021). Pressure vests (also known as anxiety wraps) were more highly rated by owners, with 44% of respondents reporting improvements when using them, but there is currently limited empirical evidence on the benefits of their use (Riemer, 2020).

Psychopharmacology

Medication for noise-related fears aims to safeguard the welfare of the patient by alleviating the negative emotional states of fear and anxiety. Reducing the associated behavioural signs may also prevent injury to the patient and potentially property damage (in those dogs digging or trying to escape), as well as limiting the resulting negative impact on the owner–dog relationship. Additionally, treating noise-related fears early may prevent generalisation of the problem to associated environments and other noises.

When using medication or other adjunctive products, it is important they are used as part of a broader behaviour modification programme as detailed above to maximise success. While there is no consensus on when medication is needed for treating noise-related fears, or when it should be selected over another adjunctive product, more severe cases are typically more likely to require medication as part of treatment.

Severity can be established by questioning an owner about the behavioural signs their dog shows – as a rough guide, a higher severity is suggested in cases where a dog shows:

- A higher number of behavioural signs of fear
- Behavioural signs for a longer duration
- Behavioural signs at a higher frequency
- Prolonged recovery time after the noise trigger ceases.

An online owner questionnaire developed by veterinary behaviourists (sponsored by Ceva) can be useful to screen the severity of signs of noise fear, as well as monitor response to treatment. This is available at: http://surveys.ethometrix.com/s3/CEVAssq.

Veterinarians should be selecting and prescribing products proven to be effective for treating noise-related fears in dogs, and several medications have been licensed for this indication in recent years.

Medication options

The concept of 'short-term' and 'long-term' medications is a helpful distinction in understanding different categories of psychotropic medication. Short-term medication generally has a fast onset of action (works quickly after administration) and often has a short duration of action. These medications can be useful for situational problems or emotional reactions such as noise fears (eg fireworks, thunder), either provided ahead of a predicted noise event, or immediately after the noise is heard. Long-term medica-

tion generally has a longer onset of action and is used over a longer duration. It is often dosed daily over a long period of time for ongoing problems relating to mood and temperament. Problems may include generalised fears and anxieties (including noise sensitivities where the dog is exposed regularly and/or unpredictably to the triggering noise). A longer period of treatment is required to facilitate relearning, as part of a broader behaviour modification programme, with treatment duration often lasting 6–12 months, sometimes lifelong.

Short-term medications

There are currently two licensed short-term medications which are available for the treatment of noise fear and anxiety in dogs.

Dexmedetomidine oromucosal gel (Sileo, Orion Corporation)
This is an alpha-2-adrenoreceptor agonist, which reduces arousal through reducing the effects of noradrenaline (Korpivaara et al, 2017). It is available as an oromucosal gel, applied via a plastic syringe. It has a rapid onset of action of just 30 minutes and is licensed to be re-dosed every 2–3 hours for up to 5 consecutive doses. It can be used ahead of a predicted noise event, or administered immediately when signs of fear/anxiety in response to noise are observed.

Imepitoin (Pexion, Boehringer Ingelheim)
This is a partial agonist benzodiazepine, which works via the gamma aminobutyric acid system (Engel et al, 2019). Pexion is given at 30 mg/kg twice daily for 2 days before an anticipated noise event and can be continued throughout the period of exposure to noise. At the time of writing, alpha-2-adrenoreceptor agonist tasipimidine (Tessie, Orion Corporation) is licensed for the short-term alleviation of situational anxiety and fear in dogs triggered by noise or owner departure, but is not yet available in the UK.

Other short-term medications

A range of other non-licensed 'short term' medications can be used, with studies of varying quality supporting such use. Non-licensed medications should be prescribed through the use of the prescribing cascade, and recommendations should be made on evidence-based veterinary medicine principles. Examples of agents include benzodiazepines (diazepam; Herron et al, 2008), alprazolam (Crowell-Davis et al, 2003), alpha-2-adrenoreceptor agonists (clonidine; Ogata and Dodman, 2011), serotonin-2A/2C antagonist/reuptake inhibitors (trazodone; Harting et al, 2018) and gabapentinoids (gabapentin; Bleuer-Elsner et al, 2021).

A special note on acepromazine: acepromazine is a phenothiazine – a neuroleptic tranquiliser which blocks dopamine receptors in the brain, thus decreasing dopamine. This results in reduced motor function; however, sensory perception can be unchanged. Historically, it was used for treating behaviour problems, especially noise sensitivities, but it does not appear to alter stress responses when used in dogs before ground or air transportation (Bergeron et al, 2002). Anecdotally, acepromazine may potentially further sensitise (especially to noise) those individuals to whom it is administered (Overall, 2013). The use of phenothiazines such as acepromazine are thus not recommended as sole agents for treating behaviour problems where fear or anxiety involved, and alternative products should be considered.

Long-term medications

While there are no licensed long-term medications for noise-related fears in dogs, numerous products can be considered including clomipramine (a tricyclic antidepressant; Crowell-Davis et al, 2003) and fluoxetine (a selective serotonin reuptake inhibitor; Ibáñez and Anzola, 2009). These often take weeks to months to reach optimum effect, and are typically reserved for those cases with more chronic issues. While licensed only for short-term alleviation of noise fears, imepitoin can also be consider for medium- to long-term use for fear/anxiety-based problems, including those related to noise (McPeake and Mills, 2017).

It is recommended that cases in which long-term medications are being considered are referred to a veterinary behaviourist to advise accordingly, unless the referring vet themselves are knowledgeable about psychoactive medications and would be working within their area of competency. Medication(s) chosen should always be tailored to the individual based on a thorough review of the behavioural history (screening for concurrent fears and anxieties) and medical history (screen for underlying disease, potential drug interactions or contraindications) and should always be provided alongside management advice and a behaviour modification programme that is feasible for both the patients and their caretaker within the daily constraints of everyday life.

Considering referral

While mild noise-related fears may be managed with sufficient time and expertise within first opinion practice using the above guidance, consider offering referral for all cases, which includes moderate-to-severe noise-related fear, which worsens/progresses over time, dogs with sensitivity to other noises in addition to fireworks and the presence of behavioural co-morbidities may warrant a different treatment approach. When dealing with such cases, consider offering immediate referral to a clinical animal behaviourist/veterinary behaviourist for assessment and development of a tailored behaviour modification programme.

Referral options

There are numerous registers of clinicians available online and searchable by location, with examples of several from the UK and North America below:

- Certificated clinical animal behaviourists (UK): https://www.ccab.uk
- Animal behaviour and training council (UK): https://abtc.org.uk/
- RCVS advanced practitioner companion animal behaviour (UK): https://findavet.rcvs.org.uk/find-a-vet-surgeon/by-advanced-practitioner/companion-animal-behaviour/
- RCVS recognised specialist behavioural medicine (UK): https://findavet.rcvs.org.uk/find-a-vet-surgeon/by-specialist/behavioural-medicine/
- EBVS European veterinary specialist in behavioural medicine (Europe): https://ebvs.eu/specialists/find-a-specialist?countryId=0&specialistTitleId=5&search=

KEY POINTS

- Noise-related fear in dogs has a multifaceted nature; it is not simply a behavioural issue, but a complex emotional and physiological response. This fear can be triggered by various noises, especially those which are sudden and loud such as fireworks and thunderstorms, and significantly affects a dog's psychological and physical well-being.
- The ability to recognise and diagnose noise-related fear in dogs accurately is crucial. The behaviours that can accompany this fear in dogs and hence can aid the accurate identification of this emotion includes a range of behavioural signs, and understanding these signs is key for timely and effective intervention.
- There are various treatment and management strategies for noise-related fear. A tailored approach that considers the individual dog's needs and circumstances is important.
- Veterinarians play a critical role in managing noise-related fear in dogs. Therefore, vets must stay informed about the latest research and treatment methods and work proactively with pet owners in addressing these issues.
- Educating and involving dog owners in the treatment process is essential. A collaborative approach should be used, where owners are equipped with the knowledge and tools to manage their pets' fear responses effectively, enhancing the overall quality of life for their canine companions.

- American college of veterinary behaviorists (North America): https://www.dacvb.org/

Treatment of noise-related fear in a multi-modal manner is optimal for a good prognosis. Allowing for consideration of the individual animal, their clinical and behavioural history and the general environment as well as focussing on the specific noise-related fear produces a holistic approach that is most likely to safeguard the development of the issue and promote improvement of the behavioural response.

Conclusions

This comprehensive guide on noise-related fear in dogs underscores the critical importance of understanding, recognising, preventing, diagnosing and effectively treating this prevalent issue. The intricate interplay between a dog's emotional response to noise and associated behavioural manifestations calls for a nuanced approach in diagnosis, management and treatment. Noise-related fear is not a singular phenomenon, but a complex interplay of a range of factors that can significantly impact a dog's quality of life.

For veterinary professionals, staying informed and proactive in the prevention, management and treatment of noise-related fear in dogs is imperative. It is essential to recognise the multifaceted nature of this condition, encompassing not only the immediate behavioural responses but also the potential long-term clinical implications. As practitioners in the field of animal health and welfare, veterinarians play a pivotal role in mitigating the impacts of such fears. This includes not only the application of current knowledge and treatment strategies but also a commitment to ongoing education and awareness and potential referral of cases to expert peers.

The responsibility extends to early detection and intervention, which can prevent the escalation of noise-related fear into more severe behavioural and physiological problems. Additionally, veterinarians are positioned uniquely to educate and guide pet owners in understanding and managing their pets' fear responses. This collaborative approach between veterinarians, veterinary staff pet owners, and, when necessary, behaviourists and other dog professionals is crucial in ensuring the well-being of dogs facing these challenges and their human companions alike. CA

Conflict of interest

Kevin McPeake has previously conducted research funded by Boehringer Ingelheim and worked as a consultant for Ceva Animal Health.

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