



Review of dog training methods: welfare, learning ability, and current standards

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SPEAKING FOR ANIMALS

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1. Introduction

1.1. Background

The British Columbia Society for the Prevention of Cruelty to Animals (BC SPCA) aims to develop humane standards for professional dog trainers in British Columbia. This document, which provides an evidence-based review of the impact of common dog training methods, was developed to support this process. To reflect the scientific evidence available on this topic, the focus of this document is on the impact of various dog training methods on dog welfare and learning ability (e.g., behavioural and physiological indicators); the dog-human relationship; and training success.

After the Introduction, this document is organized into six main sections: reward-based versus aversive-based techniques; electronic shock devices; other collars and restraining devices; hanging and helicoptering; welfare within reward-based methods; and public perceptions about training methods. Each section begins with a review of the scientific evidence, followed by a review of existing standards and positions by various relevant expert and regulatory organizations (including Government, humane societies, and veterinary associations; see Table 1). Summaries for each section are available in a Summary Box at the beginning of each section. Summaries of each study are provided in the Appendices at the end of this document.

Table 1. Names and acronyms of organizations with existing standards or positions on animal training

Acronym	Organization Name
ABTC	Animal Behaviour & Training Council
ACVB	American College of Veterinary Behaviorists
APDT	The Association of Professional Dog Trainers
APDT UK	Association of Pet Dog Trainers UK
APDT Australia	Association of Pet Dog Trainers Australia
ASV	Association of Shelter Veterinarians
AVA	Australian Veterinary Association
AVSAB	American Veterinary Society of Animal Behavior
BVA	British Veterinary Association
BSAVA	British Small Animal Veterinary Association
CAPDT	Canadian Association of Professional Dog Trainers
CCPDT	Certification Council for Professional Dog Trainers
CFHS	Canadian Federation of Humane Societies
CHS	Calgary Humane Society

Acronym	Organization Name
CVMA	Canadian Veterinary Medical Association
EHS	Edmonton Humane Society
ESVCE	European Society of Veterinary Clinical Ethology
IAABC	International Association of Animal Behaviour Consultants
KC	The Kennel Club (UK)
PPG	Pet Professional Guild

1.2. Interpretation of scientific evidence

1.2.1. Surveys

While some empirical studies have been conducted, a large portion of scientific research assessing the consequences of using reward-based versus aversive-based methods (section 2.3) has relied on dog guardians' responses to surveys. These guardian-reported data are less powerful than direct observation, because they rely not only on guardians' honest and unbiased reporting, but also on guardians' accurate recall of past events. Moreover, such surveys generally reveal *associations* between factors rather than *causality*. For example, a finding that dog guardians who report using more positive punishment also report having more aggressive dogs does not imply that dogs who are trained using positive punishment become more aggressive. An equally plausible explanation is that guardians whose dogs are more aggressive are more likely to resort to using positive punishment in an attempt to eliminate this undesirable behaviour. However, this finding does indicate that positive punishment has not proven effective in eliminating aggressive behaviour.

1.1.2. Physiological data

A few studies utilized physiological measures (e.g., salivary or urinary cortisol, heart rate) to determine the effects of specific training methods on dog welfare. Interpretations of physiological data in the context of dog training are difficult: physiological data are related to animals' state of arousal (high or low) rather than emotional valence (positive or negative). For example, elevated cortisol levels or heart rate are associated with both negative events such as aggression, restraint or pain, but also with positive stimuli such as sexual or physical activity (Moberg, 2000). Therefore, physiological measures are likely confounded in animals during training, especially in situations where the dogs are actively running or chasing.

1.3. Identifying poor welfare in dogs

Many studies in this document assess dog welfare through the occurrence of so-called 'stress related behaviours' and changes in specific physiological parameters. What these behaviours and physiological parameters are has been established by means of historical studies that assessed dogs' reactions to chronic stress and/or exposure to aversive stimuli.

For example, one seminal study attempted to provide more data on behavioural and physiological responses in dogs subjected to experimental stressors by exposing six beagles to acoustic stress (Beerda et al., 1997). The aversive stimulus was noise of 3000 Hz and at a level of 70-95 dB presented intermittently and randomly. During this acoustic stressor, the dogs increased their frequency of tongue out, snout lick, paw lift and body shake. The animals' posture was also lower during the acoustic stressor; specifically, the position of the ears, tail and body was lowered. Dogs' heart rate increased, as did salivary cortisol.

The results of Beerda et al.'s (1997) study corroborated the results of an earlier study by Schwizgebel (1982). This author assessed dogs' behavioural reactions to what he termed "harsh" versus "soft" trainers. Harsh trainers used voice punishment, hitting with the hand or leash, kicking, and kneeling. Trainers who did not use these methods were classified as "soft". Dogs subjected to the harsh trainers were found to display more frequent licking of the snout, lifting of the front paw, and lowering of the body. Vocalizations were only displayed by dogs 'trained' by the harsh instructors.

These and other studies form the basis of our understanding of dog behaviour under stressful situations.

2. Reward-based vs. aversive-based methods

2.1. Summary

Dog Welfare:

- 4 of 4¹ empirical studies found that training with aversive-based techniques lead to more stress related behaviours in the dogs compared to training with reward-based techniques
- Stress-related behaviours persisted even after the dogs were trained and the aversive stimulus was no longer used, suggesting that the verbal cues themselves had become aversive
- Among dogs who experienced aversive-based training, those who received a higher proportion of aversive-based methods exhibited poorer welfare during training
- 2 of 2 studies featuring the judgement bias test found that dogs trained with aversive-based techniques were slower to approach ambiguous locations, which has been interpreted as an indicator of negative affective states
- 7 of 7 surveys found that more frequent reported use of aversive-based techniques, whether alone or in combination with reward-based techniques, was associated with more frequent reporting of aggression and other problem behaviours
- More frequent use of R+ alone was associated with less frequent reporting of aggression and other problem behaviours

Dog-Human Relationship:

- 1 of 1 studies found that dogs trained with reward-based methods showed more consistent evidence of secure attachment to their guardians
- Dogs trained with R+ were more likely to gaze at their guardians during training than dogs trained with R-, but dogs trained with R+ may have simply been looking to their guardians for treats
- Dogs whose guardians reported using P+, P- or R- were less likely to interact with their guardian and with a stranger during a play session than dogs of guardians who reported using R+
- Guardians who reported more frequent use of R+ also reported a closer bond to their dogs and more perceived attachment

Training Success:

- More frequent reported use of P+, R- or P- was associated with lower obedience and learning ability

¹ Results are reported as a ratio to concisely show the number of studies on a certain topic and their rate of agreement. For further clarity, results are reported separately for empirical studies and surveys.

- More frequent reported use of R+ was associated with better obedience and learning ability

Existing Standards:

Organizations advocating against the use of aversive-based training methods include: CAPDT, BC SPCA, Montreal SPCA, CHS, EHS, PEI Humane Society, AVSAB, ASV, ACVB, RSPCA UK, RSPCA Australia, BVA, BSVA, AVA, PPG, APDT UK, APDT Australia and The KC (UK)

2.2. Introduction

Animal training techniques rely on principles of classical conditioning and operant conditioning. The most common methods are explained in Table 2.

Table 2. Basic learning processes involved in animal training, their common core tools, and definitions

Learning process	Core tools	Definition
Classical conditioning		An involuntary response that results from experiences that occur before the response. In this learning process, a neutral stimulus (e.g., bicycle) is paired with an unconditioned stimulus (e.g., loud noise) that elicits an involuntary or reflexive response (e.g., fear). After enough pairings, the neutral stimulus becomes a conditioned stimulus and elicits the response by itself (e.g., bicycle elicits fear)
	Counter-conditioning	A conditioned stimulus (e.g., bicycle from example above) is paired with an unconditioned stimulus (e.g., food) to undo the effects (e.g., fear) of an earlier association
	Desensitization	Gradual exposure to a stimulus that elicits an undesirable response (e.g., bicycle from example above), but below the threshold that elicits the response (e.g., from very far away). With time the animal becomes less reactive to the stimulus and can tolerate it at higher intensities (e.g., from very close). A desensitization protocol usually involves counter-conditioning as one of the steps.
	Habituation	Gradual decrease in the magnitude of an involuntary response after it has been elicited repeatedly
Operant conditioning		A change in behaviour that occurs as a result of experiences that occur after the response. In this learning process, a voluntary response (e.g., jumping when greeting guardian) will be more or less likely to occur again in the future depending on whether its immediate consequence is positive (e.g., praise) or negative (e.g., reprimand)
	Positive reinforcement (R+)	Increasing the likelihood of a desired behaviour (e.g., sitting when greeting guardian) by applying a rewarding stimulus (e.g., food) when the behaviour is performed
	Negative reinforcement (R-)	Increasing the likelihood of a desired behaviour (e.g., sitting when greeting guardian) by removing an aversive stimulus (e.g., releasing choke chain) when the behaviour is performed
	Positive punishment (P+)	Decreasing the likelihood of an undesired behaviour (e.g., jumping when greeting guardian) by applying an aversive stimulus (e.g., choke chain) when the behaviour is performed
	Negative punishment (P-)	Decreasing the likelihood of an undesired behaviour (e.g., jumping when greeting guardian) by removing a rewarding stimulus (e.g., attention from the guardian) when the behaviour is performed

Yellow: training tools that can be used in a reward-based or aversive-based manner

Green: training tools that are always reward-based

Red: training tools that are always aversive-based

Blue: training tools that are considered to be reward-based by some and aversive-based by others

The various methods used in animal training can generally be classified as *reward-based* or *aversive-based* (the latter can also be referred to as *punishment-based*) (see legend for Table 2). This classification is not dependent on whether the techniques actually involve the use of rewards, nor whether they have the word ‘punishment’ in them (in the literal sense, ‘punishment’ is simply something that will decrease the likelihood of a behaviour occurring again in the future). Rather, techniques are generally classified as aversive-based if they involve the use of anything that the dog may² perceive as physically or emotionally uncomfortable; techniques that do not involve such stimuli are generally considered to be reward-based.

As such, positive reinforcement methods are always considered to be reward-based, while negative reinforcement and positive punishment methods are always considered to be aversive-based. Authors differ in their classification of negative punishment, with some considering it to be reward based (e.g., Arhant et al., 2010; Blackwell et al., 2012; Casey et al., 2014; Casey et al., 2021; Guilherme Fernandes et al., 2017; Vieira de Castro et al., 2019; Vieira de Castro et al., 2020; Woodward et al., 2021) and others aversive-based (e.g., Hiby et al., 2004; Rooney and Cowan, 2011). The methods used in classical conditioning (e.g., counter-conditioning; desensitization; habituation) can be reward-based or aversive-based, depending on what stimulus is being used and what automatic response is being elicited (e.g., reward-based if using food rewards to counter-condition fear to a bicycle or aversive-based if using a shock collar to condition fear of snakes).

When assessing the various impacts of training methods, the bulk of scientific research has investigated the general effects of training dogs with reward-based versus aversive-based methods, rather than assessing the impact of individual training techniques. It is also common for various organizations to advocate for or against the general use of aversive-based methods rather than individual tools or techniques. The following section describes this scientific research and summarizes the standards and positions put forth by relevant animal organizations on this topic.

2.3. Scientific evidence

Two scientific literature reviews on the effects of aversive-based training methods in dogs were published in rapid succession. The author of the first review (Ziv, 2017) concluded that aversive training methods pose risks to dog welfare because these methods have “undesirable and unintended”

² The wording ‘*may* perceive’ is chosen here because the aim of the scientific literature on the effects of aversive based training methods is specifically to assess whether these methods lead to negative physical and/or emotional consequences.

outcomes. He further concluded that there was no evidence to suggest that aversive training methods are more effective than reward-based methods. He recommended that dog handlers and trainers use positive reinforcement and avoid positive punishment and negative reinforcement techniques.

The authors of the second review (Guilherme Fernandes et al., 2017) assessed essentially the same scientific studies as the author of the first review, but came to a more conservative conclusion: they wrote that the existing literature suggests that aversive-based methods cause stress in dogs to some degree, but that strong conclusions cannot be drawn until there are more scientific studies on the relationship between training methods and dog welfare. Specifically, they recommended that 1) more empirical studies (versus surveys) be conducted; 2) future empirical studies should assess the entire range of aversive-based training tools and techniques, instead of the current focus on shock collars; and 3) future empirical studies should test companion dogs of various breeds instead of subpopulations of laboratory or police dogs.

The articles reviewed by these authors, and more, are reviewed in the following sections.

2.3.1. Impact on dog welfare

Four studies assessed the effects of reward-based versus aversive-based training methods on the occurrence of stress-related behaviours through direct observation of dogs during training.

Two recent studies evaluated dog welfare using a cognitive bias test. In this task, dogs first learn the association between a “positive” location in which a bowl always contains a reward, and a “negative” location in which the bowl is empty. After this discrimination is achieved, they are presented with bowls in ambiguous locations placed half-way between the positive and the negative locations. A shorter latency (i.e., going faster) to these ambiguous locations suggests the dog expected the reward to be present. This positive expectation of ambiguity has been interpreted as an indicator of a positive affective state and thus a measure of optimism. Conversely, a longer latency (i.e., going slower) may indicate a relatively negative affective state, understood as an indicator of pessimism.

Casey et al. (2021) compared 50 dogs who had been trained using two or more aversive-based methods featuring positive punishment with 50 dogs trained using only reward-based techniques. They observed that dogs whose training included aversive methods were slower to go to the ambiguous locations, which may reflect a more negative mood state compared to dogs trained without aversive methods. The authors concluded that dogs exposed to aversive-based training methods may experience longer-term negative mood states indicating poorer welfare.

Vieira de Castro et al. (2020) evaluated the welfare of 92 dogs who participated in training schools considered to be aversive-based (Group Aversive; over 75% of methods intended to be aversive-based; 28 dogs), mixed (Group Mixed; 20%- 40% of methods intended to be aversive-based; 22 dogs) or reward-based (Group Reward; no methods intended to be aversive-based; 42 dogs) both within training contexts and outside of training.

This study employed a cognitive bias test to evaluate welfare outside of the training context, and, in line with the findings from the previous study, it was observed that dogs from Group Aversive exhibited a longer latency to approach all locations. Additionally, they examined welfare during training by conducting observations of three training sessions in which they analyzed stress behaviours, overall behavioural state and panting. They also obtained saliva samples after these sessions, and compared them to baseline samples taken on non-training days. Dogs from Group Aversive exhibited more stress-related behaviours such as body turn, crouch, body shake, yawn and lip lick. Moreover, dogs from this group were more frequently in tense and low behavioural states, panted more during training, and showed a lower frequency of excited and relaxed behavioural states compared to the other groups. Dogs from Group Mixed also displayed more stress-related behaviours, were more frequently tense and panting, and exhibited a lower frequency of excited behaviours during training compared to Group Reward. Regarding physiological measures of stress, the baseline cortisol concentrations did not differ between the groups, and the post-training cortisol levels did not differ between Group Mixed and Group Reward, nor between Group Mixed and Group Aversive. However, dogs from Group Aversive exhibited higher post-training increases in cortisol levels than dogs from Group Reward.

All in all, these results indicate poorer welfare in Group Aversive and Group Mixed during training, and a less positive state in dogs from Group Aversive than those from Group Reward outside of training sessions. In addition, these results highlight the importance of the proportion of aversive-based methods, as dogs who experienced a higher proportion of aversive-based methods exhibited a poorer welfare during training.

Deldalle and Gaunet (2014) recorded the occurrence of six stress-related behaviours in dogs responding to the verbal cue 'sit' and walking on-leash. These dogs had previously been trained to perform these tasks at training schools that used either positive reinforcement (24 dogs) or negative reinforcement (26 dogs). When being asked to sit, dogs who had been trained using negative reinforcement were more likely to display at least one of the six stress-related behaviours; they displayed lower posture; and they were more likely to display mouth licking and yawning. Because dogs

were already well-trained, no negative reinforcement was applied in the negative reinforcement group after the verbal cue 'sit' was given; therefore, the display of stress-related behaviours, even in the absence of a negative stimulus, suggests that the verbal cue itself had become aversive. No differences were seen between the two groups of dogs during walking on-leash. Since walking on-leash did not require any vocal cue from the guardians in either group, the authors hypothesized that the stress-related behaviours seen after the dogs were asked to sit were provoked by the vocal cue itself.

Haverbeke et al. (2008) observed 33 handlers training Belgian military working dogs on 'obedience' and protection work. Each handler used a mixture of reward-based methods (most common: stroking the dogs and verbal praise) and aversive-based methods (most common: pulling on the leash and hanging dogs by their collar). Dogs' posture was significantly lower after the use of aversive-based methods than reward-based methods. Dogs who were more compliant displayed more stress-related behaviours, suggesting that the handlers' cues may have themselves become aversive to these compliant dogs, just as they appear to have become aversive to the compliant dogs in the negative reinforcement group in Deldalle and Gaunet's (2014) study above. This negative association may not have yet formed in the least compliant dogs.

The majority of scientific research assessing the welfare consequences of using reward-based versus aversive-based methods has relied on dog guardians' responses to surveys. The main focus of these surveys has been on the link between training methods and the occurrence of aggression and other problem behaviours.

Stellato et al. (2021) surveyed 2,217 dog guardians from 38 countries (over half of them being from Canada, and a third from the USA) in order to assess risk-factors associated with fear and aggression in veterinary clinics. Among other things, they examined the way guardians managed unwanted behaviours in general everyday contexts as well as during veterinary visits. They found that the use of spray bottles, but notably not other positive punishment techniques like verbal corrections, smacking, or shock collars, was related to higher reported aggression scores at the vet. With regards to negative punishment, ignoring unwanted behaviours was associated with lower reported aggression scores at the vet when guardians used it in general contexts, but the reported aggression scores increased if they ignored aggressive behaviours towards the staff during visits.

In a survey of 1,111 dog guardians in the UK and Ireland, Lord et al. (2020) found increased odds of reporting a problem behaviour in nine-month-old dogs for guardians who used positive punishment or combined positive reinforcement and positive punishment, compared to those that only used positive

reinforcement. Moreover, guardians who only used positive reinforcement were less likely to consider potentially concerning behaviours (e.g., pulling on the leash, poor recall) as problematic. LaFollette et al. (2019) surveyed 111 military veterans from the USA who were diagnosed with posttraumatic stress disorder and had psychiatric service dogs. In terms of dog welfare, they observed that more frequent use of positive punishment was associated with reports of increased fear, while more frequent use of positive reinforcement was associated with increased playfulness. Similarly, Mariti et al. (2017) surveyed 906 Italian dog guardians regarding their behaviour during veterinary visits. They found that dogs who were usually scolded for refusing treatments at home were also reported to be more aggressive at the vet's office.

Casey et al. (2014, 2013) conducted a survey of 3,897 dog guardians in the UK, asking about the training methods they had used and the levels of aggression displayed by their dogs. They found that a guardian's reported use of positive punishment or negative reinforcement, compared to the use of positive reinforcement or negative punishment, was associated with a 3.8 times greater risk of aggression between dogs in the household, a 2.5 times greater risk of aggression towards dogs outside of the household, a 2.9 times greater risk of aggression towards family members, and 2.2 times greater risk of aggression towards unfamiliar people outside of the house. However, the type of training technique accounted for <15% of the variance between aggressive and non-aggressive dogs, suggesting that other factors were more important in the development of aggression.

After surveying 140 dog guardians in the United States, Herron et al. (2009) found that very few reported that their dog had responded aggressively to a reward-based training method. In contrast, ~40% of guardians reported that their dog had responded aggressively to being hit, kicked, or growled at by the guardian, and ~30% reported aggression in response to the use of a muzzle, forced release of an item from the dog's mouth, the dog being held down ("alpha roll" or "dominance down"), grabbing jowls, or a stare down. Approximately 10% of guardians reported aggression in response to a remote activated or bark-activated shock collar or a choke/pronged collar.

In a similar study that surveyed 1,053 guardians of English Springer Spaniels in the USA, Reisner et al. (2005) found that ~28% of guardians reported that their dog had responded aggressively to physical punishment and ~21% to the threat of physical punishment, and ~13% to verbal scolding. In contrast, ~3% reacted aggressively to a kiss, pet on the head or pet on a back.

Arhant et al. (2010), who surveyed 1,276 dog guardians in Austria, found that more frequent reported use of positive punishment was associated with more 'aggression and excitability', which

included behaviours such as growling, snapping and barking at dogs or people; resource guarding; and excitability when a doorbell rings. Only in small dogs (<20 kg), more frequent reported use of positive punishment was also associated with 'anxiety and fearfulness', which included fear of unknown situations, loud noises, crowds and other dogs; and restlessness, panting and trembling. In large dogs (>20 kg) only, certain reward-based responses to unwanted behaviour were associated with negative outcomes. Specifically, more frequent distraction with food or play was associated with increased aggression, while comforting the dog with petting or speaking was associated with both aggression and anxiety. Finally, a higher proportion of reported use of rewards relative to total training methods was associated with less aggression and less anxiety in all dogs.

In a survey of 192 dog guardians in the UK, Blackwell et al. (2008) found that guardians who reported using only positive reinforcement reported the fewest problem behaviours in their dogs. Type of training method also affected specific problem behaviours: aggression and fear (avoidance) were reported to be highest by guardians who had used positive punishment in their training, whether alone or in combination with positive and/or negative reinforcement. In contrast, aggression and fear (avoidance) were reported to be lowest by guardians who reported using only positive reinforcement.

Hiby et al. (2004), who surveyed 326 dog guardians in the UK, described that the frequency with which guardians reported using aversive-based methods, which included negative punishment, was correlated with the number of current problem behaviours (chosen from a list of 13 behaviours that included aggression, fear and excitability). Guardians who reported using only aversive-based methods or a mixture of aversive-based and reward-based methods reported the greatest number of current problem behaviours in their dogs. The lowest number of current problem behaviours was reported by guardians who claimed to use only reward-based methods.

2.3.2. Impact on the dog-human relationship

Vieira de Castro et al. (2019) examined dog-human attachment in 34 dyads of dogs and guardians, 17 recruited from aversive-based schools and 17 from reward-based schools. They carried out a counterbalanced version of the Ainsworth Strange Situation Test. This task comprises a series of episodes which differ in the presence or absence of the guardian and a stranger. Some of the behaviours that are examined as indicators of the attachment bond include a secure base effect expressed through exploration and playfulness when guardians are present, separation distress when they leave, and greeting and following them when they return. Results showed that dogs trained with reward-based

methods played more when guardians were present, and greeted and followed them more than the stranger. However, these differences were only observed in one of the procedural orders, highlighting the sensitivity of this test to order effects. The authors concluded that dogs trained with reward-based methods showed more consistent evidence of a secure attachment. Moreover, they suggested that it is not that reward-based training itself generates a secure attachment, but instead that aversive-based training may be related to a decrease of the secure base effect.

Furthermore, in their survey of veterans with psychiatric service dogs, LaFollette et al. (2019) found that more frequent use of positive punishment was associated with less perceived closeness as well as a decrease in eye contact. Conversely, those guardians who reported more frequent positive reinforcement training reported having a closer bond with their dogs and them exhibiting more attachment behaviours, including eye contact.

In addition to recording stress-related behaviours described in the previous section, Deldalle and Gaunet (2014) also documented the impact that positive versus negative reinforcement training had on the frequency with which dogs gazed towards their guardian as an indicator of the dog-human relationship. Dogs who had been trained using positive reinforcement gazed at their guardian significantly more often after being asked to sit and while walking on-leash than dogs who had been trained using negative reinforcement. However, more frequent gazing at the guardian in the positive reinforcement group may have been an artefact of dogs looking for treats rather than indicating the quality of the dog-human relationship.

Rooney and Cowan (2011) surveyed 53 dog guardians about their preferred training methods, and subsequently observed these guardians interacting with their dog during relaxed social play. These authors considered negative punishment (e.g., removal of social contact, food or toy) to be aversive-based. Dogs of guardians who reported using more aversive-based techniques were less likely to interact with a stranger (the experimenter) during relaxed social play. In addition, dogs of guardians who reported using more physical punishment, specifically, were less interactive with both a stranger and their guardian during play.

2.3.3. Training success

LaFollette et al. (2019) also found an association between trainability and training methods in their survey of military veterans with psychiatric service dogs. Specifically, a more frequent use of

positive punishment was associated with reports of less trainability. Conversely, a more frequent use of positive reinforcement was associated with higher trainability.

Rooney and Cowan (2011), who surveyed dog guardians about their preferred training methods and subsequently observed them interacting with their dog during social play, also observed: 1) guardians training their dog on a novel task, and 2) dogs' responses to being asked to sit, lie and stay. Dogs' ability to learn the novel task was significantly lower for dogs whose guardians reported using more aversive-based methods (including negative punishment) and higher for those whose guardians reported using more reward-based methods. Learning ability on the novel task was also better for dogs who received more total rewards during training on this task. Finally, dogs' response to the 'sit, lie and stay' cue was better for dogs who interacted more with their guardian during play.

In addition to investigating the relationship between training method and dog welfare described in the previous section, Arhant et al. (2010) also asked guardians about their dogs' overall 'obedience' (which included questions such as: responding to cues such as sit, down, heel or recall even when distracted; not pulling on leash; learning new cues quickly; and handing over objects when asked). They found that a higher proportion of reported use of rewards relative to total training methods was associated with better obedience in both small and large dogs. In large dogs (>20 kg), disobedience to verbal cues was associated with more frequent reported use of positive punishment, as well as more frequent use of distraction with food or play (a reward-based response to unwanted behaviour).

Finally, in addition to their work on the association between training methods and current behaviour problems, Hiby et al. (2004) also asked guardians about the methods they had used to train their dog on seven common tasks and their dog's obedience for each of these tasks. Different methods were reported to be most effective in training different tasks, but aversive-based techniques, which included negative punishment, were never the most effective for any task. Guardians who reported using only reward-based methods reported highest obedience scores, followed by guardians who reported using a combination of reward-based and aversive-based methods, and then those who reported using only aversive-based methods.

2.4. Existing standards and positions

The BC SPCA has a position statement against the use of training methods that involve coercion and force, stating that "aversive, punishment-based techniques may alter behaviour, but the methods fail to address the underlying cause and, in case of unwanted behaviour, can lead to undue anxiety, fear,

distress, pain or injury” (BC SPCA, 2016). Other Canadian animal protection organizations have similarly taken a stance against the use of aversive-based training techniques. The Montreal SPCA’s policy on Training and Behaviour Modification states that the organization “opposes the use of physical corrections or punishment as well as psychological intimidation in animal training, and instead supports the use of force-free, positive reinforcement-based methods for training and treating behaviour problems in animals” (Montreal SPCA, 2015). The Calgary Humane Society’s position statement on the Training of Dogs states that the organization “supports the use of humane training methods and opposes training methods based on dominating the animal, use of aggression or methods that cause pain, fear and/or undue stress” (CHS, 2022). Similarly, the Edmonton Humane Society’s position statement on Humane Training Methods for Dogs is that the Society “supports the humane training of dogs which includes force-free, evidence-based techniques that foster the human-dog relationship. [...] opposes the use of aversive techniques and devices that cause fear, anxiety, stress, pain or injury in dogs” (EHS, 2021). Finally, the Prince Edward Island (PEI) Humane Society has a position statement on Humane Training of Companion Animals that reads as follows: “The PEI Humane Society advocates the humane treatment and training of companion animals. We rely on science-based research which has conclusively proven that positive (reward and force-free) based training methods are both more humane and more effective than training methods which involve: intimidation, confrontation, violence, reprimands or domination or have the potential to cause physical or mental injury to the animals, causing potential danger to humans” (PEI Humane Society, n.d.).

Internationally, RSPCA UK’s policy on Animal Training Aids states that the organization is “opposed to the use of any aversive training method, to train and control companion animals and believes that reward based methods should be used instead” (RSPCA UK, 2014). The policy further defines aversive training techniques to include electric shock collars, anti-bark collars, choke chains, prong collars and physical force or coercion (e.g., hitting or forcing into a position). RSPCA Australia’s policy on Training states that “training methods must be humane and must not cause injury, pain, suffering or distress to the animal”, that their organization “supports reward-based training methods involving positive reinforcement” because it is “the most humane and effective training method”, and that “training programs based on aversive stimuli, dominance, force or punishment must not be used as they are inhumane and can cause long-term behavioural problems” (RSPCA Australia, 2014). In the UK, the Department for Environment, Food and Rural Affairs (DEFRA) published a Code of Practice for the Welfare of Dogs which instructs people to “use positive reward-based training” and states that “training

which includes physical punishment may cause pain, suffering and distress. These techniques can compromise dog welfare, lead to aggressive responses and worsen the problems they aim to address” (DEFRA, 2017).

Several veterinary associations have made strong recommendations against the use of aversive-based methods in animal training. The Canadian Veterinary Medical Association’s position statement on Humane Training Methods for Dogs states that “training methods that reward desired behaviour (i.e., positive reinforcement) are strongly recommended” and that “aversive training techniques are strongly discouraged” (CVMA, 2021). They further state that “behaviour modification is recommended but needs to be performed below the threshold that would cause distress, anxiety or fear” (CVMA, 2021).

The American College of Veterinary Behaviorists (ACVB) indicates in their position statement that they stand “against training methods that cause short or long lasting pain, discomfort or fear. Aversive training methods can be dangerous to people as well as animals and pose a threat to animal welfare by inhibiting learning, increasing behaviors related to fear and distress, and causing direct injury” (ACBV, n.d.a). Similarly, the American Veterinary Society of Animal Behavior “recommends that only reward-based training methods are used for all dog training” and conclude that “aversive training methods have a damaging effect on both animal welfare and the human-animal bond” (AVSAB, 2021). Likewise, in the recently published Guidelines for Standards of Care in Animal Shelters, the Association of Shelter Veterinarians indicates that “It is unacceptable to use physical force as punishment to modify animal behavior” (ASV, 2022).

The British Veterinary Association and the British Small Animal Veterinary Association published a policy on Aversive Training Devices for Dogs stating that the organizations “have concerns about the use of aversive training devices to control, train or punish dogs” and that “instead [it] supports and recommends positive reinforcement methods” (BVA & BSAVA, n.d.). In their policy on the Use of Behaviour-Modifying Collars on Dogs, the Australian Veterinary Association states that “the use of positive reinforcement training methods is recommended for modifying the behaviour of dogs” (AVA, 2022). Moreover, in their policy regarding The Use of Punishment and Negative Reinforcement in Dog Training, they indicate that “punishment and negative reinforcement should not be used in attempts to change the behaviour of dogs. Training of dogs is best achieved through positive reinforcement” (AVA, 2021).

Furthermore, some individual veterinarians have developed reward-based certification programs for other veterinarians and pet guardians. For example, Dr. Sophia Yin’s Low Stress Handling®

education and certification program teaches methods that do “not involve coercion, dominance, or other negative training methods” (Yin, 2009). A similar initiative is Dr. Marty Becker’s Fear FreeSM education and certification program that teaches individuals how to “prevent and alleviate fear, anxiety and stress and improve an animal’s emotional wellbeing”. They launched a Fear Free Animal Trainer Program that aims to teach qualified trainers how to implement Fear Free’s gentle techniques with their clients’ pets at the veterinarian’s office. According to the Fear Free website, over 55,000 professionals have become Fear Free Certified and more than 84,000 professionals have registered for the various Fear Free veterinary and pet professional programs (Fear Free, 2020).

Several associations for professional dog trainers have also taken an explicit stance against the use of aversive-based techniques, including the international organization Pet Professional Guide (PPG), the Canadian Association of Professional Dog Trainers (CAPDT), the Association of Pet Dog Trainers (APDT) UK, and APDT Australia. Some have endorsed a less prescriptive approach. For example, the International Association of Animal Behaviour Consultants (IAABC) and The Association of Professional Dog Trainers (APDT) in the USA and Canada (CAPDT; in addition to their clear stance against aversive-based methods) support the LIMA (Least Intrusive, Minimally Aversive) approach to training (APDT, n.d.; IAABC, n.d.) while the Certification Council for Professional Dog Trainers (CCPDT) in the USA supports the Humane Hierarchy (CCPDT, 2015). LIMA and Humane Hierarchy prioritize the use of reward-based techniques, but theoretically allow use of aversive-based techniques after reward-based methods have failed. However, both APDT and CAPDT have placed limits on their endorsement of the LIMA approach. For example, in their position statement, the APDT indicates that “there are no training or behavior cases which justify the use of intentional aversive punishment-based interventions in any form” and that “trainers who use aversive tools [...] are not practicing LIMA as described and used within APDT”. (APDT, n.d.).

Similarly, the CAPDT prohibits the use of so-called Strong Aversives which are listed in their Severe Techniques and Outdated Procedures (STOP) document (2022b). In their guidelines they state that “members must attest they will not use the strong aversives listed” and, those considering use of positive punishment methods are required to consult a CAPDT expert panel for “advice on next steps and a ruling on whether the use of the method is appropriate in the case where the trainer proposes its use” (CAPDT, 2022a). The PPG explicitly opposes the Humane Hierarchy, stating that “progressing up the hierarchy to more invasive and aversive protocols is merely a matter of time for individuals who are not proficient in their craft, or do not have the requisite scientific knowledge or education to understand

why this strategy is so problematic in the first place” (PPG, 2017a). The Kennel Club in the UK is also “firmly against the use of any aversive training devices. Instead, we recommend that pet owners and trainers use positive, rewards-based tools and methods” (The KC, n.d.).

Finally, two renowned and popular schools for animal trainers – The Academy for Dog Trainers and Karen Pryor Academy for Animal Training & Behavior (KPA) rely on an entirely reward-based curriculum. KPA graduates are endorsed by the American College of Veterinary Behaviorists (ACVB, n.d.b) and Dr. Sophia Yin, founder of Low Stress Handling® (Yin, 2014).

3. Electronic shock collars

3.1. Summary

Dog Welfare:

- 3 of 3 empirical studies reported yelping and other vocalizations in response to shock
- 2 of 2 empirical studies found more immediate stress-related behaviours in dogs trained with vs. without a shock collar (e.g., lowered ears, lip licking, lifting of front paw)
- 2 of 2 empirical studies reported long-term negative effects in dogs trained with vs. without a shock collar (increased alertness; persistent stress-related behaviours around the handler)
- 2 of 2 empirical studies reported no difference in cortisol between dogs trained with vs. without a shock collar
- 1 of 1 empirical study found that timing of shock delivery influenced cortisol levels
- 1 of 1 survey found that real life use by unqualified handlers may result in higher welfare risks than those observed in controlled studies

Training Success:

- 1 of 1 empirical studies found lower training success in dogs trained with shock collars vs. dogs who received positive reinforcement
- 2 of 2 empirical studies found no difference in training success between shock collars vs. other aversive-based collars
- 3 of 4 surveys found lower success in training by guardians who used shock vs. other reward- or aversive-based methods; the fourth found no difference

Existing Standards:

- Shock collars are illegal in 10 European countries and several states in Australia
- Organizations advocating against the use of electronic shock include: CHS, Nova Scotia SPCA, AVSAB, RSPCA UK, RSPCA Australia, PPG, APDT, CAPDT, APDT UK, the KC UK, APDT Australia, ACVB, BVA, BSAVA, AVA, the US FDA

3.2. Introduction

Perhaps no other dog training tool has been more studied than the electronic shock collar. There are three basic types of collars, categorized on the basis of how the shock is activated. The ‘remote-activated shock collar’ is activated by the push of a button on a hand-held remote control; the ‘anti-bark shock collar’ is activated by a dog’s bark; and, the ‘electronic boundary fence’ is activated by a radio signal from a wire usually buried underground around the perimeter of a property; the shock is

delivered when a dog comes within a predetermined distance of the buried wire (Polsky, 1994). For remote-activated collars, most models allow users to activate a warning cue (e.g., sound or vibration) before the electric shock, offering dogs the opportunity for avoidance learning (Cooper et al., 2014).

Different brands and models of shock collars vary widely in the voltage, number and duration of the impulses they deliver, but the technical information specific to each device is not usually available when purchasing a collar (Lines et al., 2013; Polsky, 1994). One study comparing 13 different remote activated collars found that peak voltage varied between the collars from 950 V to 7350 V (when resistance was set to 500 k Ω); the duration of a momentary stimulus varied from 4 ms to 420 ms; the number of voltage pulses in a momentary stimulus ranged from 2 to 272; the duration of a continuous stimulus ranged from 7 s to infinite; and the number of pulses per second in a continuous stimulus varied from 10 to 514. Moreover, it was shown that the voltage and current delivered by a given collar depended on the exact contact area on the dog, and on the amount of hair between the probes and the dog's skin, both of which changed constantly when the dog was active. Wet fur also affected the voltage and current by decreasing resistive impedance (Lines et al., 2013).

Several scientific studies have assessed the effects of training with a shock collar versus a reward-based method. Others have compared the use of shock collars with other punishment-based collars, such as prong or spray collars. To reflect this, the following section summarizes the scientific literature on the effects of training with versus without a shock collar, and training with a shock collar compared to other punishment-based collars. Technical information about the collars (e.g., voltage) is given whenever this information was made available by the authors.

3.3. Scientific evidence

3.3.1. Impact on dog welfare

3.3.1.1. Shock collar versus reward-based method

All the studies on the use of shock vs. other reward-based methods have made their observations during training on a recall/stop chasing task. Cooper et al. (2014) investigated behavioural and physiological measures of dogs' emotional state during training on a recall task with or without the use of a shock collar. Dogs in Group A (n=21) were trained with a shock collar by one of two trainers experienced in their use (trainers had been nominated by The Electronic Collar Manufacturers Association); dogs in Group B (n=21) were trained by these same two trainers, but without the use of a shock collar; and dogs in Group C (n=21) were trained by one of two trainers belonging to the

professional training organization APDT UK. Trainers in Group A worked with their preferred make and model of shock collar, and set the collar to the shock intensity they deemed appropriate.

The results showed that dogs in Group A spent more time tense, showed more yawning, and spent less time interacting with the environment than dogs in Group C. There were no differences in the other postures (e.g., tail position) or stress-related behaviours (e.g., lip lick, paw lift) measured in this study. In Group A, panting was twice as common and yelping was five times as common, but these differences were not significant. Closer inspection revealed that both of these behaviours were displayed at high frequencies by a small number of dogs in Group A, and that yelping and other vocalizations were significantly more frequent with increasing shock intensity. There were no differences in salivary or urinary cortisol between the three groups. Dogs in Groups A and B received about twice as many verbal cues as dogs in Group C. These results suggest that electronic shock collars, even when used according to best practice by experienced trainers, cause stress (tense, yawning) and pain (yelping), and that the latter are more frequent with increasing shock intensity.

Schalke et al. (2007) compared changes in heart rate and salivary cortisol between three groups of laboratory Beagles in response to training with a shock collar. The collar, a Teletakt micro 3000, was set to the highest level resulting in peak voltage of 700-1760 V and peak current of 0.82-1.25 A for less than 1 ms. The 'aversion' group ($n=5$) was shocked when they touched a rabbit dummy they had previously been trained to hunt; the 'here' group ($n=4$) was shocked when they did not obey a previously trained recall cue during the hunt; and the 'random' group ($n=5$) was shocked arbitrarily and out of context during the hunt. The dogs were shocked once per day for up to three days if they continued to hunt; and they continued to be exposed to the dummy for three days after they stopped hunting (i.e., became compliant; no more shock). There were no differences in heart rate between groups. Cortisol values were compared to a baseline where the dogs had been allowed to hunt unimpeded. When the authors combined dogs' cortisol levels from the first day of shock delivery and the first day they became compliant (no more shock), cortisol values were significantly higher from baseline in the 'random' group than in the other two groups. When combining values from the first two days of shock delivery and the first day dogs became compliant, cortisol was significantly more elevated from baseline in the 'random' group compared to the other two groups, and it was also significantly higher in the 'here' group compared to the 'aversion' group. In the Discussion, the authors stated that, compared to baseline, cortisol increased ~31% in the 'aversion' group, ~160% in the 'here' group, and 328% in the 'random' group; however, it is not clear which values were used to make these calculations.

Nonetheless, this finding suggests that electric shock *per se* causes cortisol to rise, and that the timing of shock delivery plays a role in how much it rises. The authors interpreted the results in terms of predictability and controllability. They explained that dogs in the 'random' group could not predict nor control the electric shocks; hence their cortisol was highest. Dogs in the 'here' group could predict the electric shock (they associated disobedience with punishment), but because the recall cue was trained in a different context and without the dummy, they could not control their initial reaction to chase the dummy. In the 'aversion' group, dogs were able to associate the dummy with the electric shock, and were thus able to predict and control the stimulus.

Finally, Christiansen et al. (2001) tested the effects of using electronic shock collars to prevent dogs from chasing/hunting sheep. In the first test, 114 hunting dogs of three breeds (Norwegian elkhounds (grey), English setters and hare hunting dogs) were walked on leash along a path where they were exposed to four sudden encounters with novel stimuli, including an unfamiliar human. The authors measured dogs' reactions and latency to react to each stimulus. Next, dogs were fitted with a shock collar (Dog Radartron™) and let into a large fenced area containing a flock of sheep. If dogs came within 1-2 m of the flock, they received a shock of 3000 V and 0.4 A lasting 1 s. Shocks were repeated if the dogs did not withdraw. These tests were repeated one year later.

Only 17 dogs received electric shocks (on average 2.6 shocks per dog) the first year. Upon retesting a year later, dogs who had received an electric shock the previous year noticed the sudden stimuli at larger distances compared to dogs who had not been shocked the previous year. Shocked dogs also approached the unfamiliar human more slowly than non-shocked dogs. These results suggest that the shocked dogs had become more vigilant/alert, which may indicate that they had become more anxious or fearful. However, when questioned, the guardians of these dogs reported that their dogs had neither become more fearful nor more aggressive towards people or dogs. The dogs' experiences with electric shock or training in the year between the two tests are not known.

3.3.1.2. Shock collar versus other punishment-based collar

Studies comparing shock collars to other punishment-based collars include two that observed working dogs during obedience training, and one that observed shelter dogs trained to stop barking. In the most recent study, Salgirli et al. (2012) evaluated behavioural and physiological reactions of 42 Belgian Malinois official police dogs to training with a shock collar (Dogtra 600 NCP/2®), a prong collar, or a quitting signal. For the quitting signal, dogs had been trained prior to the experiment to withdraw immediately from a toy when the signal was given. During the experiment, dogs were asked to heel

while a human decoy tried to provoke the dogs to attack, and when they did, the correction (shock, prong or quitting signal) was given by the handler. Dogs were tested with each of the three corrections in random order on three different days.

'Maximum backward ear position' was displayed by ~38% of dogs in response to the shock collar and ~64% in response to the prong collar, but this difference was not statistically significant. The authors reported that the prong collar caused 'lower body posture' than the shock collar, but the *p*-value (statistic) for this result is not given. However, in reference to this result, the authors refer the reader to a figure showing that 'crouching' was displayed by ~34% of dogs in response to the shock collar versus ~47% in response to the prong collar, and that 'lowering of the back' was seen in ~43% of dogs in response to the shock collar versus ~31% in response to the prong collar. Dogs vocalized more often in response to the shock collar (~60%) than to the prong collar (~23%). Salivary cortisol values are difficult to interpret, because dogs showed lower values after the application of the shock or the prong collar than during baseline. Cortisol values did not differ after the application of the shock vs. the prong collar.

Only 3 or 4 (both numbers are reported in the article) of the 42 dogs responded to the quitting signal, suggesting that the dogs had not generalized the signal to this novel context (i.e., they did not understand it). This is not surprising, given that the signal was trained using a toy and not a human decoy. One critic stated that "expecting the dogs to generalize the quitting signal with a toy to a different scenario seems unrealistic" (Ziv, 2017). Due to the low number of dogs responding to the quitting signal, no meaningful statistical analyses could be performed for this training method.

The authors concluded that "the electronic shock collar [...] induced less stress to cease the unwanted behaviour in comparison to the other training methods" (p. 535). It is unclear how the authors reached this conclusion, given that the only statistically significant differences between the shock and prong collars (the quitting signal was ineffective and therefore could not be analyzed) were that the prong collar caused lower body posture, but the shock collar caused more vocalizations; vocalizations may have been interpreted as indicating pain – and no stress – and were disregarded in the authors' conclusion.

Schilder and van der Borg (2004) evaluated the short and long-term effects of training dogs with a shock collar. To assess the immediate effects of receiving an electric shock, the authors observed 107 shocks delivered to 32 dogs (mostly German shepherds) during training for the official police or watchdog certificate. Dogs were shocked for not doing what was asked of them, the most frequent of which were not letting go, heeling in front of the handler, biting a criminal at the wrong time, or reacting

too slowly when asked to heel. Upon receiving a shock, 69% of the dogs lowered their ears; 56% displayed tongue flicking; 53% produced a high sounding yelp; 44% displayed avoidance behaviour; 41% squealed; 41% lowered their tail; and 25% lifted the front leg. Many other stress-related behaviours were also displayed, but by fewer dogs. Only in response to 12 of the 107 shocks did the dogs not display a negative reaction.

To assess the long-term effects of training with a shock collar, the authors also observed 16 of the dogs from the previous group plus an additional 15 control dogs who had never received an electric shock, although they had been trained using harsh methods, including prong collars, choke collars, beatings and kicking. For this part of the study, the authors observed these dogs in situations when no electric shocks were delivered. The dogs were observed first on the training grounds during a free 2-min walk on-leash (no verbal cues were given), and then during obedience exercises and during protection work. Finally, these dogs were also observed during a free walk on-leash and during obedience exercises, but in a novel setting – a park.

During the free walk on the training grounds, dogs who had previously received electric shocks (hereafter referred to as ‘shocked dogs’) had lower ear position than control dogs, but body and tail positions did not differ. More shocked dogs displayed lip licking, but other stress-related behaviours were too infrequent to be compared. During obedience work on the training grounds, shocked dogs again displayed lower ear position, and body and tail positions again did not differ. Of the five stress related behaviours displayed frequently enough to be compared statistically, shocked dogs displayed more tongue flicking and lifting of the front paw, while the other three behaviours (lip licking, yawning and turning away) were displayed equally between the two groups. Finally, during protection work, shocked dogs displayed lower ear position, more paw lifting, and more frequent walking with completely flexed limbs. Dogs in both groups displayed equal amounts of tongue flicking and lip licking.

When walking on-leash in a novel setting, shocked dogs again displayed lower ear position, but stress-related behaviours were too infrequent to be compared. During obedience work in the novel setting, shocked dogs had lower ear position and displayed more tongue flicking. Both groups of dogs displayed lip licking, lifting of the front leg, yawning and turning away, but these were equally frequent between the two groups.

The authors also found that during leash walking, shocked dogs carried their tails lower and displayed lip licking and lifting of the front paw more often on the training grounds compared to the park. Ear position, tongue flicking, yawning, and turning away were shown in equal amounts in both

settings. There were no differences between the training grounds and the park for control dogs, except that they displayed more tongue flicking on the training grounds during obedience work.

Taken together, these results suggest that: 1) the use of electronic shock collars is immediately both painful (yelping, squealing) and stressful (lowered ears and tail, tongue flicking, avoidance, lifting front leg) to dogs; 2) shocked dogs continue to display signs of stress in the presence of their handlers and when responding to what they were asked to do, even when no shock is delivered; 3) dogs generalize this stress to a novel setting when in the presence of their handler and responding to what they were asked to do; and, 4) other harsh training methods (prong collar, choke collar, beating or kicking) cause similar consequences, albeit to a lesser degree than the shock collar.

Steiss et al. (2007) investigated the physiological impact of two types of anti-bark collars in shelter dogs: an electronic shock collar ($n=6$; Deluxe Bark Collar Model DBC100; time from detection of bark to correction: 152 ms) and a lemon-scented spray collar that did not contain citronella ($n=8$; Model SBC100; time from detection of bark to correction: 67 ms). A control group ($n=7$) wore an inactivated collar. Measures were taken during and after three sessions where an unfamiliar dog was walked in front of each test dog's run three times. There were no differences in activity, plasma cortisol or plasma ACTH between any of the groups. The first day when dogs were exposed to the shock or spray, plasma cortisol values in both experimental groups rose to 169% of their baseline values (cortisol values were at 97% of baseline in the control group), but this increase was not statistically significant from baseline, and the elevated value was still well within the reference range for baseline cortisol values in dogs. Lack of a statistically significant difference from baseline may be due to the low sample size in this study. This study was funded by the manufacturer of the electronic shock collar used in this study.

3.3.1.3. Surveys about shock collar use

Masson et al. (2018a) surveyed 1,251 dog guardians to examine the use of different types of shock collars (bark-activated collars, electronic boundary fence collars, and remote-controlled collars) in France. The prevalence of use was higher than expected, with 26% of respondents reporting having used at least one of these devices. Remote-controlled collars were the most common (14.2%), followed by bark-activated collars (11.9%) and electronic boundary fence collars (4.5%). Regarding the acquisition of these devices, 40% of respondents reported buying the shock collars from the internet, and 35% from pet/gardening stores; only 9.2% purchased them from trainers or veterinarians. This raises concerns about real life use by unqualified handlers (i.e., people that did not receive professional training or advice in the use of the collars), which may affect welfare even further than what has been shown in

controlled experimental conditions. For instance, dogs may receive a higher number of shocks, which may also be unpredictable in their timing. Alarming, in this sample there was a high number of reported physical wounds due to shock collar use (7% or 23/330; 16 of them from the use of bark-activated collars). This further supports the notion that the number of shocks administered in everyday life is higher than expected and the welfare risks might be increased when unqualified handlers use these collars.

It is interesting to highlight that 95.2% of non users and, notably, 77.9% of the users, were favorable to the implementation of regulations for the distribution of shock collars. Moreover, 58% of the users wanted a restricted use and 14% of them even were in favour of a ban when asked about the need for regulations.

3.3.2. Impact on the dog-human relationship

No scientific studies appear to have assessed the effects of electric shock on the dog-human relationship.

3.3.3. Training success

3.3.3.1. Shock collar versus reward-based method

Two articles (China et al., 2020; Cooper et al., 2014) analysed data from the same sample of dogs who were trained with (Group A) or without (Groups B and C) the use of a shock collar by trainers who were either for (Groups A and B) or against (Group C) the use of shock in training.

China et al. (2020) recorded the speed and reliability of dogs' responses during a recall task as well as for the sit command. The results indicate that dogs from Group C (called Control 2 in this article) responded significantly better to both commands after a single instruction and also had shorter response latencies than dogs from the shock collar group.

Cooper et al. (2014) surveyed the dogs' guardians for overall satisfaction with their dog's recall after training. Approximately 92% of guardians reported that there had been an improvement in their dog's obedience on the recall task. There were no differences in the responses between the three groups, suggesting the guardians found the two methods equally effective. However, guardians of dogs who had been trained with a shock collar reported being less confident in applying the training method used with their dog than guardians whose dogs had been trained without the shock collar.

Christiansen et al. (2001) used a remote-activated shock collar to shock dogs when they came within 1-2 m of a flock of sheep. Dogs were tested twice, one year apart. The first year, 17 of the 114 dogs received electric shocks. The following year, 12 dogs received electric shocks, but only one of those dogs had received a shock the previous year.

Arnott et al. (2014) surveyed 812 herding dog guardians about their practices on Australian farms. Only 7% of guardians reported using electronic shock collars to train their dogs to herd stock; those who used shock collars were less likely to retain their dogs as working dogs compared to those who did not use shock collars.

Finally, Blackwell et al. (2012) surveyed dog guardians in the UK about the training methods they had used for recall or chasing problems. Of the 83 guardians who reported using electronic shock collars, a lower proportion reported success with their training than those who reported using other aversive-based methods ($n=123$) or reward-based-methods ($n=373$). Success was reported to be highest by guardians who used reward-based methods.

3.3.3.2. Shock collar versus other punishment-based collar

Dinwoodie et al. (2021) examined the effectiveness of various treatments of canine aggression through a survey completed by 800 dog guardians for 963 dogs reported as exhibiting aggression. While most of the findings are outside of the scope of this review, they found that the use of an anti-bark collar decreased the probability for successful treatment of overall aggression. It should be considered that in this study, “anti-bark” collars comprised different kinds of punishment-based collars including electric, ultrasonic and spray collars, with no distinction among them in the reported results.

Masson et al. (2018a) examined the use of different types of shock collars in France. Some guardians reported their dogs exhibited an increase in so-called normal behaviours together with a decrease of excitement when using the shock collar. The authors point out that this apparent success could also be explained by learned helplessness, particularly considering the use of shock collars by unqualified handlers. Moreover, the reported efficacy was higher for continuous use during the dogs' lives, especially for bark-activated collars and electronic boundary fence collars. This suggests behaviour modification may not have been very effective, as the issue was not solved without continued use of the collar. Additionally, 42% (139/330) of the guardians reported they were not satisfied after trying the shock collar on their dog, and only 58 % of the users said they would recommend the shock collar to others. Nevertheless, it should also be noted that 42.8% of the guardians (57.9% of users, and 37.4% of

non-users) considered that shock collars could solve behaviour problems better than any other training method.

With regards to success in training dogs on a recall/stop chasing task, Salgirli et al. (2012) observed police dogs being trained not to attack a human decoy using a shock collar or a prong collar. There were no statistically significant differences in learning ability between the two groups – 39 vs. 32 out of 42 dogs had learned the correct behaviour after training with the shock versus the prong collar, respectively.

With regards to success in training dogs not to bark, Steiss et al. (2007), who fitted shelter dogs with a shock collar or a lemon-scented spray collar, found that both groups barked significantly less by the second day of wearing the collar (<2 s total barking time versus >60 s at baseline), with no differences between the two groups. There was no statistically significant difference in the mean number of corrections on the first day between the two groups (4 vs. 2 for the shock vs. the spray collar, respectively). Both groups received zero corrections by day 3.

Juarbe-Diaz and Houpt (1996) evaluated the satisfaction of nine dog guardians (one dropped out before the end) after they had their dogs wear two types of anti-bark collars: an electronic shock collar worn for two weeks, and a citronella spray collar worn for another two weeks. The shock collar used in this study ceased to deliver shocks if the dog ignored it and continued to bark. Overall, 50% of the guardians reported satisfaction with the shock collar compared to 89% with the citronella spray collar. A decrease in barking was reported by 25% of the guardians when their dog wore the shock collar compared to 78% when their dog wore the citronella spray collar. Fifty percent reported no change at all with the shock collar; reportedly some dogs would make a painful cry and then continue to bark; while others did not show any visible reaction. All but one guardian expressed a preference for the citronella spray collar. Unfortunately, no statistical tests were performed in this study to determine whether differences in effectiveness and guardian satisfaction were significant. However, using the numbers reported by the authors, a Fisher's Exact test reveals that the difference in effectiveness (25% shock vs. 78% spray) just reached statistical significance with a one-tailed test, but just missed significance with a two-tailed test. There is no statistical difference in the number of guardians who reported satisfaction with each collar (50% shock vs. 89% spray).

3.4. Existing standards and positions

The use of electronic shock collars is illegal in ten European countries: Austria, Denmark, Finland, Germany, the Netherlands, Norway, Slovenia, Sweden, Switzerland and Wales. Legal bans are being implemented in England, Scotland and France. They will also be banned in Flanders, Belgium after 2027. Their use is also forbidden by law in the Australian states of New South Wales and South Australia, and in the federal district Australian Capital Territory. In the state of Victoria, shock collars may only be used by veterinarians, qualified dog trainers, or people acting under their instruction. In Spain, the autonomous communities of the Basque Country, Castilla-La Mancha and Murcia have legislations that indicate that shock collars can only be used by qualified professionals under veterinary prescription and control. Meanwhile, in Madrid and Galicia, the legislation bans the use of electronic collars or other devices that “may result in harm”, but the use of vague wording has left its enforcement open to public interpretation. A nation-wide ban has been proposed but it is still under debate. In New Zealand, the law requires that electronic shock collars only be used for the training of serious behavioural problems if other training methods have failed and when the dog is likely to be euthanized without their use. In the Canadian province of Québec, shock collars are not recommended per the Animal Health Protection Act. In Montreal, shock collars are prohibited under the by-law concerning domestic animals.

A large number of organizations have spoken out against the use of electronic shock collars. Among animal protection organizations, these include the CHS (“chooses not to use [...] shock collars due to their potential to cause stress, pain, and fear, especially when used by people with no expertise, experience, or credentials in humane dog training”) (CHS, 2022); the Nova Scotia SPCA (“does not support the use of shock collars for containment or training as there are other viable, safe and proven training and containment options available”) (Nova Scotia SPCA, 2015); RSPCA UK (“opposed to the use of any aversive training method [...]; aversive training techniques include electric shock collars”) (RSPCA UK, 2014); and RSPCA Australia (“opposed to the use of any electronically activated or other devices which deliver electric shocks, such as anti-barking collars and invisible boundaries; such devices are inhumane as they inflict pain, involve punishment and can be used to abuse animals” (RSPCA Australia, 2014). Similarly, the American Veterinary Society of Animal Behavior indicates that “an appropriate trainer should avoid any use of training tools that involve pain” including electronic shock collars (AVSAB, 2021).

Among associations for professional dog trainers, the PPG’s position statement states that “electric shock in the guise of training constitutes a form of abuse and should no longer be a part of the

current pet industry culture of accepted practices, tools or philosophies” (PPG, 2017a). APDT UK’s Code of Practice states that “electric shock devices in any form [...] should not be used, recommended, advertised or sold by members” (APDT UK, 2020). APDT Australia’s Code of Ethics states that members shall “actively reject the use of harsh, physical, psychological, coercive and aversive methods in the training of dogs (including the use of electric shock collars)” (APDT Australia, 2013). In addition, the organization’s position statement states that “shock is unacceptable and unnecessary for the training of companion animals” and that it “believes there are significant risks involved in making shock and prong collars available to deal with problems that can be addressed by more humane methods” (APDT Australia, n.d.), The American organization APDT – which otherwise supports the LIMA approach to training – states that the “use of electronic training collars can result in trauma to your dog” and that they “should not be used by novice dog guardians or trainers” (APDT, 2017). The CAPDT includes shock collars in their list of Severe Techniques and Outdated Procedures (CAPDT, 2022b) and prohibit the use of “electric shock or vibration devices in any form (note that an electric vibration collar is exceptionally permitted in the case of deaf dogs when the vibration has been trained to elicit a positive conditioned emotional response, not as 'warning' of a potential aversive.)”. Finally, the Kennel Club in the UK states they “fully support a total ban on the use and sale of electric shock collars” (The KC, n.d.)

Among North American veterinary organizations, the CVMA’s position statement declares that “remote controlled shock collars are not considered a necessary method of training or behaviour modification” (CVMA, 2021). This is a notable change from their 2015 policy in which they stated that “electronic collars should only be used by a certified and/or experienced trainer or behaviourist, and only after all other training and/or behaviour modification methods have failed” (CVMA, 2015). Nevertheless, they still state that “the use of non-remote electronic collars ([...] such as with electronic fencing systems) should be used with caution and are only acceptable as an alternative to tethering if [...] the property is not amenable to traditional fencing. [...]”. The organizations further acknowledges that “some dogs become very agitated from the stimulus however minimal, and may become fearful of their environment” (CVMA, 2021). The American College of Veterinary Behaviorists advises veterinarians not to recommend to their clients trainers who use shock collars for basic obedience (ACVB, n.d.b).

Internationally, the European Society of Veterinary Clinical Ethology has adopted a position statement on Electronic Training Devices, which states that “members of ESVCE position strongly against the use of e-collars in dog training, [...] and urge all European countries to take an interest and position in this welfare matter” (ESVCE, 2019). The organization argues that not only is there no strong evidence

to justify shock collar use on dogs, but on the contrary, there are many reasons to never use them. This position was taken following a thorough literature review of the pros and cons of using electronic shock training devices in dogs (Masson et al., 2018b).

The BVA and BSAVA's policy on Aversive Training Devices for Dogs expresses "concerns about the use of aversive training devices to control, train or punish dogs [...] include electric collars which are used as a means of punishing or controlling behaviour of companion animals is open to potential abuse and incorrect use of such training aids has the potential to cause welfare and training problems" (BVA & BSAVA, n.d), these organizations are therefore "calling for a complete ban on the sale and use of electric pulse training collars for dogs in order to help protect animal welfare". In Australia, the AVA's policy on the Use of Behaviour-Modifying Collars on Dogs states that "collars designed to inflict pain, discomfort or fear to achieve behavioural change should not be used on dogs" and that "Invisible fence containment collars should not be used unless their use can increase the safety and overall welfare of the animal. When used, there must also be a visible boundary marker indicating where a dog will receive the potentially painful electronic stimulus" (AVA, 2022)

In the UK, ten organizations have published a Joint Statement on Electronic Training Devices and Pinch Collars in which they declare the following: "We, the organizations above, are opposed to the use of electronic training devices (ETDs) and pinch collars (also known as prong collars) believing they are unacceptable and unnecessary as a means of training and controlling dogs. We are calling for the sale and use of these devices to be prohibited". The ten signatories are RSPCA UK, the Association of Pet Behaviour Counsellors, Blue Cross for Pets, Dogs Trust, Wood Green – The Animals Charity, Battersea Dogs & Cats Home, Animal Behaviour & Training Council, The Mayhew Animal Home, APDT UK, and The Kennel Club. Moreover, the UK's Animal Behaviour and Training Council questions the use of coercive methods and concludes that "Apart from the poor and unintended results, there are welfare and ethical issues to consider. How can it be right to cause any animal pain in order to motivate it to carry out your wishes when humane methods are not only available but produce better long term results?" (ABTC, 2021).

Dog training expert Dr. Karen Overall published an editorial in the *Journal of Veterinary Behavior* in which she wrote: "Absolutely, without exception, I oppose, will not recommend, and generally spend large amounts of time telling people why I oppose the use of shock collars, prong collars, choke collars, and any other type of device that is rooted in an adversarial, confrontational interaction with the dog. Without exception, such devices will make my anxious patients worse and allow the anger level of my

clients to reach levels that are not helpful and may be dangerous” (Overall, 2007). Veterinarian, animal behaviourist and animal trainer Dr. Ian Dunbar has famously said the following about the use of shock in training: “To use shock as an effective dog training method you will need: A thorough understanding of canine behaviour; a thorough understanding of learning theory; impeccable timing. And if you have those three things, you don’t need a shock collar.”

In April 2020, the US Food and Drug Administration banned electrical stimulation devices from being used on human patients in attempts to stop them from engaging in self-injurious or aggressive behaviour. The rule states that these devices “present risks of a number of psychological harms including depression, posttraumatic stress disorder (PTSD), anxiety, fear, panic, substitution of other negative behaviors, worsening of underlying symptoms, and learned helplessness [...] physical risks of pain, skin burns, and tissue damage” (FDA, 2020).

Although there are no peer-reviewed publications on the effects of using electronic boundary fences in dog training, Dr. Richard Polsky did publish a commentary on this topic in the *Journal of Applied Animal Welfare Science* (Polsky, 2000). The author reviewed transcripts from depositions and other legal documents of personal injury claims due to dog attacks. Five lawsuits were filed in which injury was caused by a dog who had been trained, or was in the process of being trained, to avoid shock with an electronic boundary fence. In all cases, the dogs appear to have attacked a familiar or unfamiliar human immediately after being shocked upon entering the signal field. In four of the five cases, the dogs were described as docile with no prior history of aggression. The author concluded that manufacturers of electronic boundary fences need to acknowledge the risks involved with this system and make consumers aware that some dogs could attack a person as a result of having received an electric shock.

4. Other collars and restraining devices

4.1. Summary

Punishment-based collars:

- 1 of 1 survey found that guardians who used prong and choke collars reported lower satisfaction with their dogs' overall behaviour and leash-walking behaviour
- 1 of 1 survey found that guardians reported an improvement in fear aggression towards dogs due to use of slip, choke and prong collars
- 1 of 1 empirical study found citronella and scentless spray collars to be equally effective in reducing barking in small dogs, with neither collar affecting dogs' anxiety level

Regular collars and harnesses:

- 1 of 1 empirical studies found evidence of poorer welfare with neck collars than harnesses
- 1 of 1 empirical studies found higher intraocular pressure with neck collars than harnesses
- 1 of 1 empirical studies used a canine neck model and found risk of injury with leash pulling for all of the tested collars (seven types differing in material, width and padding).
- 1 of 1 empirical studies found evidence that head collars result in poorer welfare than neck collars

Existing Standards:

- Prong collars are illegal in 4 countries and one state in Australia; choke collars are illegal in 2 countries
- Organizations advocating against the use of prong and choke collars include: CAPDT, CHS, AVSAB, RSPCA UK, RSPCA Australia, RSPCA South Australia, the Canadian Advisory Council on National Shelter Standards, CVMA, ACVB, ABTC, PPG, APDT UK, and APDT
- Organizations advocating against the use of anti-bark collars other than shock collars include CAPDT, RSPCA Australia, RSPCA South Australia, AVA, ABTC, and APDT UK

4.2. Introduction

While most studies on behaviour modifying collars have focused on the electronic shock collar, a few have assessed the impacts of other types of punishment-based collars, such as prong collars or citronella spray collars. A couple of studies have also compared the effects of restraining dogs with a traditional neck collar versus a head collar or a harness. Although harnesses are not proper 'collars', they are included here as they serve the same purpose as the former two restraining devices. Because so few studies are reviewed in this section, the subsections 'impact on dog welfare', 'impact on the dog-human relationship and 'training success' are omitted here.

4.3. Scientific evidence

4.3.1. Punishment-based collars

In their survey examining treatments of canine aggression, Dinwoodie et al. (2021) found that guardians reported an improvement in fear aggression towards dogs after using a slip, choke, or prong collar. However, the authors are cautious with their interpretation of the results and point out that although punishment-based training equipment may seem effective initially (e.g., guardians may be impressed with the apparent control given by such equipment), its use may result in negative consequences for welfare in the long term.

Only two studies compared the effects of punishment-based collars without the use of shock. In a simple survey of 129 dog guardians in California, Kwan and Bain (2013) found that guardians who reported using punishment-based collars (described as prong and choke collars) reported less satisfaction both with their dogs' overall behaviour and with their dogs' leash-walking behaviour.

To assess the effects on welfare and learning ability of two non-shock anti-bark collars, Moffat et al. (2003) used a citronella spray collar and a scentless spray collar on small dogs (<6 kg) boarding in a veterinary hospital. The scentless spray in the latter collar consisted of HFC134A tetrafluoroethane, which is also used as propellant in bronchodilators or in gas dusters. Small dogs who barked at least five times per minute for five minutes were included in this study ($n=41$). These dogs were first fitted with a control collar (an inactivated anti-bark collar) for 5 min; if barking continued at the same level, the dogs were fitted either with a citronella spray collar ($n=18$) or a scentless spray collar ($n=20$) for another 5 min. If barking resumed in the 5 min after collar removal, the dogs were fitted with the other anti-bark collar for another 5 min ($n=9$ from the citronella group and $n=12$ from the scentless spray group, for a total of 21 dogs having worn both anti-bark collars). Dogs were also evaluated subjectively for anxiety level (none, mild or severe based on pacing, whining, panting, vigilance and activity) before and during collar placement.

Initial application of both types of collars resulted in a significant reduction in barking compared to the control collar, with no differences in effectiveness between the two groups. Of the 21 dogs who wore both collars, the citronella was effective in five cases where the scentless spray had produced no change, but in no case was the scentless collar effective where the citronella collar was not. Neither type of collar had an effect on anxiety level compared to baseline – most dogs did not change their anxiety level, some dogs became more anxious, and some became less anxious.

4.3.2. Regular collars and harnesses

Concerning the comparison between different types of collars, Carter et al. (2020) tested seven collars and a slip lead that differed in their material (nylon, leather, metal), width and padding on a canine neck model consisting of a plastic cylinder with a pressure sensor beneath the collar. They examined the effects of a range of forces applied to the leash representing a firm pull, a strong pull and a jerk. Although there were significant variations according to the type of collar and the applied forces, all of the collar types had the potential to cause injury. Moreover, they found that some collars (check chain, leather and thread collar) created more pressure on the middle of the neck compared to the sides, which could compromise internal structures, although more research is needed to further examine this possibility. The authors concluded that collars may be more suitable for displaying identity tags and handling dogs that walk consistently on a loose leash, but they may risk injury when there is pulling of the leash.

Two studies investigated the effects of restraining dogs with a neck collar versus a harness. In the more recent study, Grainger et al. (2016) recorded behavioural indicators of stress in dogs with a history of being walked on a traditional neck collar ($n=15$) or a harness ($n=15$). Dogs were first observed walking with their usual restraint device (collar or harness) and then again with the opposite device after one week of habituation. There were no differences in the frequency of stress-related behaviours when dogs were walked on collar versus harness; however, dogs whose usual restraint type was a collar had lower ear position when observed walking on either device, suggesting that dogs with a history of wearing a collar are more stressed during walks, regardless of device. However, because ear position was the only behaviour that differed between the groups, the authors advised readers to treat this result with caution until further studies are conducted on this issue. It is interesting to note that while most stress-related behaviours occurred very rarely (less than once in 20 min) or rarely (less than five times) with either device, lip licking was relatively high in both conditions (~10 times).

Pauli et al. (2006) also compared the use of a neck collar versus a harness, but the focus was on measuring the intraocular pressure caused by pulling on each restraining device. Twenty-six privately owned sled dogs who had previously been trained to pull a sled were fitted with a neck collar and a harness. A leash was attached first to the collar and then to the harness, and dogs were asked to pull for 10 s while the leash was attached to each device. Although the dogs tended to pull harder on the harness than on the collar (i.e., force of tension generated was higher with the harness), intraocular pressure increased significantly from baseline when dogs pulled on the collar (~7.4 mm Hg) but not

when they pulled on the harness (~2.3 mm Hg). Intraocular pressure increased significantly more under tension with a collar than with a harness. The authors concluded that dogs with glaucoma, weak or thin corneas, or any other conditions making them susceptible to increased intraocular pressure should wear a harness rather than a collar during exercise or activity.

Finally, in what appears to be the only study investigating the effects of wearing a head collar, Ogburn et al. (1998) compared the physiological and behavioural responses of 26 random source laboratory dogs performing basic obedience while wearing a traditional neck collar versus a head collar. Dogs were recorded wearing each device 1-2 days apart. There were no differences between the two types of collars in any of the physiological measures taken; namely, heart rate, blood pressure, respiratory rate, pupil dilation, plasma cortisol or plasma ACTH. However, several behavioural differences were found. When wearing the neck collar, dogs were more unruly and pulled at the leash more. When wearing the head collar, dogs fought the leash and pawed at their nose more, lowered their heads and ears more frequently, held their body in a crouched position more frequently, and looked less towards the handler. These results suggest that dogs wearing head collars may be more compliant, but also behave in a more subdued and fearful manner. However, by the authors' own admission, it is unlikely that these dogs had had any prior experience with head collars (this device was novel at the time of the study) but almost certainly had had experience wearing a neck collar. It is therefore possible that stress-related behaviours in response to the head collar would diminish once dogs habituated to this device. A study where dogs have had equal experience with the two devices is warranted.

4.4. Existing standards and positions

4.4.1. Punishment-based collars

Both prong collars and choke collars are illegal in Denmark and Switzerland. Prong collars, but not choke collars, are also illegal in Austria, the Netherlands, New Zealand and in the Australian state of Victoria. In the Canadian province of Québec, prong collars are not recommended per the Animal Health Protection Act. Moreover, Montreal's animal control by-law concerning domestic animals prohibits the use of choke and prong collars. In Toronto, an amendment to the Toronto Municipal Code attempted to ban prong collars and choke chains, but this prohibition was quickly repealed in March 2017 due to concerns from organizations like the Canadian Institute for the Blind.

Among the animal protection organizations, CHS (2022), RSPCA UK (2014), RSPCA Australia (2014) and RSPCA South Australia (2017) have officially voiced their opposition to the use of prong

collars and choke collars. In addition, the Canadian Advisory Council on National Shelter Standards (2020), which was gathered in 2013 at the invitation of the Canadian Federation of Humane Societies, deems as unacceptable the same disciplinary techniques listed by the CVMA and a few other organizations. The CVMA's position is that "the use of aversive devices such as choke, pinch, or prong collars are strongly discouraged in favour of more humane alternatives" (CVMA, 2021). In the United States, the ACVB also opposes the use of prong and choke collars for basic obedience (ACVB, n.d. b). The ABTC in the UK states that choke chains and prong collars are "pieces of equipment that [...] work on instilling anxiety or fear in the dog to make it behave" as well as prong collars are an "outdated, harmful type of collar" (ABTC, 2021).

Among dog trainers' association, the APDT UK's Code of Practice lists prong collars and choke chains as equipment that "should not be used, recommended, advertised or sold by members" (APDT UK, 2020). Likewise, the CAPDT includes choke, prong and spike collars as Severe Techniques and Outdated Procedures which should not be used (CAPDT, 2022b). The APDT in the United States takes a more conservative approach, stating simply that instead of using prong collars, "advances in training and equipment now offer other more humane options for feisty dogs"; and that "choke collars have, to a large extent, been replaced with newer, safer designs" (APDT, 2017). Additionally, the international organization Pet Professional Guide states that "the PPG and its members actively recommend against the use of choke and prong collars while actively promoting the use of flat buckle collars, head halters, harnesses and other types of control equipment that are safer for the animal" (PPG, 2017b).

With regards to the use of anti-bark collars other than shock collars, the CAPDT prohibits members from use of "olfactory/chemical startle" collars such as spray collars (CAPDT, 2022b). RSPCA Australia is explicitly "opposed to the use of collars that deliver aversive stimuli such as sound or scent, including citronella collars and high-pitched sound-emitting devices" (RSPCA Australia, 2014). RSPCA South Australia is also opposed to the use of citronella collars, claiming that "dogs have a highly developed sense of smell and the strong odour emitted by citronella collars is very unpleasant and aversive. Citronella collars are used as a 'quick fix' but fail to address the underlying cause of the behaviour and therefore have limited success" (RSPCA South Australia, 2017).

Among veterinary organizations, the AVA's policy on Use of Behaviour-Modifying Collars on Dogs includes collars that use citronella as "collars designed to inflict pain, discomfort or fear to achieve behavioural change [that] should not be used on dogs." (AVA, 2022).

In the UK, the ABTC also lists “gadgets that squirt a disagreeable spray at the dog when they bark” as “pieces of equipment [...] that work on instilling anxiety or fear in the dog to make it behave” (ABTC, 2021). Finally, the APDT UK’s Code of Practice lists “pet correctors emitting a hiss of cold air”, “remote controlled spray collars”, “anti-bark collars emitting spray directed onto dog’s skin” and “high frequency sound devices which are designed to startle” as pieces of equipment that “should not be used, recommended, advertised or sold by members” (APDT UK, 2020).

4.4.2. Regular collars and harnesses

Of the organizations that have voiced an opinion on the use of neck collars, head collars or harnesses, some recommend all three while others support only one. In Canada, CHS encourages the use of neck collars, head collars (Haltis and gentle leaders) and harnesses (“non pain-inducing”) when training dogs (CHS, 2022). In the United States, APDT believes traditional neck collars for dogs to be a “good first choice for training”, while harnesses should only be used for pets with diseases of the throat or neck for whom traditional neck collars would cause further damage to the throat (APDT, 2017). Dr. Sophia Yin recommended harnesses for brachycephalic dogs especially; and she preferred front-attach models over those that hook on the back. The veterinarian also recommended head collars for guardians who want to speed up training, but cautioned that dogs often need to be trained to enjoy wearing them (Yin, 2012). The CVMA recommends the use of head halters over the use of prong or choke collars (CVMA, 2021).

RSPCA South Australia recommends against the use of head collars as the first option for walking, stating that “many dogs find them uncomfortable and dogs need to be given time to adapt to wearing them” (RSPCA South Australia, 2017). The organization also recommends against the use of neck collars for dogs who pull on the leash. Instead, it hails harnesses – especially the ones that attach in the front – as its top choice for training and walking a dog, with the caveat that harnesses for dogs who pull on the leash should be used in conjunction with force-free training (RSPCA South Australia, 2017).

5. Hanging and helicoptering

Very little documentation is available on the practices of ‘hanging’, where a dog is lifted off the ground by the collar, and ‘helicoptering’, where the dog is lifted by the collar and spun around. However, one Case Report published in the Journal of Veterinary Behavior describes the case of a 1-yr old German shepherd who presented to the authors’ veterinary clinic with ataxia, incoordination and circling. Tests revealed that the dog had suffered severe brain damage (cerebral edema resulting from

ischemia). The dog had suffered this brain damage as a result of being disciplined by the guardian by being suspended a few feet in the air for 60 s by his choke chain to the point of losing consciousness (Grohmann et al., 2013). The dog was euthanized. In addition to this case, it is said that the impetus for a joint project between the Delta Society and The American Humane Association that resulted in the publication of “Professional Standards for Dog Trainers: Effective, Humane Principles” in 2001 was the following incident: During class, a dog trainer made the decision to ‘helicopter’ a dog wearing a choke chain. The dog voided her bladder and bowels before the trainer lowered her to the ground. As a result of the helicoptering, the dog was blinded due to hypoxia. The trainer was charged for animal cruelty but later found not guilty.

A few organizations have spoken out specifically against hanging and helicoptering. The CAPDT includes helicoptering as one of the Severe Techniques and Outdated Procedures (CAPDT, 2022b) that are prohibited. The CHS lists hanging and spinning (“helicopter technique”) at the end of a choke collar and leash as examples of abusive training methods. Delta Society also lists hanging a dog by leash or collar and helicoptering as techniques that should never be used (Delta Society, 2001). Finally, the ACVB advises veterinarians not to recommend to their clients trainers who recommend ““helicoptering” [...] as a means of “training” or modifying behaviour” (ACVB, n.d.b).

6. Welfare within reward-based methods

While most of the research so far has compared the effects of reward-based versus aversive-based training methods, there are two studies that examined dog welfare according to different presentations of reward-based training. Specifically, these authors analyzed the effects of partial rewarding during clicker training (Cimarelli et al., 2020; Wennmacher, 2007). This means that some clicks were not followed by the delivery of food, and should not be confounded with ratio schedules in which a number of responses are required before receiving both the click and the food.

Cimarelli et al. (2020) trained 30 dogs to put two paws on a target platform. Half of them were assigned to a 100% rewarded condition, while the other half received a reward only after 60% of the clicks. To examine the affective state of the dogs they carried out a cognitive bias test. The groups did not differ in learning speed, indicating that partial rewarding does not improve training efficacy. However, there were significant differences in the cognitive bias test, as partially rewarded dogs took longer to reach the ambiguous location suggesting a more pessimistic bias.

In her unpublished Master's thesis, Wennmacher (2007) carried a within-subject's reversal design with 2 dogs who had to learn the cues "bow" and "spin". They received a condition of continuous pairing in which each click was followed by a food reward, as well as one of intermittent pairing in which the correct behaviour had to be performed for two trials in a row before a treat was given. The author found that the partial rewarding condition negatively impacted learning as it affected the frequency, accuracy and topography of the behaviours. More importantly, in this condition they also observed an increase in noncompliance and other so-called unwanted behaviours, which included lying down, walking away from the session and refusing to come back. Despite the small sample size, the emergence of these behaviours suggests a negative emotional state.

7. Public perceptions about training methods

Recently, some authors set out to examine the factors that influence the public perception and attitudes towards different training methods. These studies are relevant because a better understanding of dog guardians' knowledge and beliefs about training provide additional context about the use of these techniques, and highlight the need for further education on methods that promote animal welfare.

With regards to the information that is available to guardians, Johnson & Wynne (2023) examined the websites of 100 dog trainers from the USA and observed that only half of them provided an unambiguous identification of the training methods they used. Nevertheless, they found some terminology that could be helpful for members of the public to determine the methodology of a trainer, as there were some specific terms that were more commonly used by trainers from certain approaches. For instance, trainers who engaged in aversive-based methods mentioned the use of "electronic collars" or "correction collars", while non-aversive trainers often used the term "shock collar", which highlights the aversive nature of this tool. Moreover, aversive-based trainers often employed the term "balanced" to refer to their approach and usually referred to "mother nature/instinct" or "pack leadership" when they described their philosophies, while non-aversive trainers frequently referred to "science" in their websites. This kind of variability increases the inconsistency of the information that is provided to the general public and may aid to create confusion when selecting a trainer. Regarding the demographics of the trainers, they observed that women were more likely to use reward-based approaches, and non-aversive trainers were more likely to be certified by a third-party organization. However, it should be

noted that the authors only focused on the gender and qualifications of the head trainer from each school, which may not have been representative of all of the trainers in each business.

Daniels et al. (2022) surveyed 235 dog guardians about dog behaviour modification in the UK, and defined 'dog trainers' as those who plan and manage the general training of dogs and 'behaviourists' as those who received specific training to work with problematic or dangerous behaviours. They found that guardians were just as likely to employ a dog trainer as a behaviourist, and they reported that both were equally able to facilitate behaviour improvement, regardless of training methods (reward-based versus combination of rewards and punishment). However, behaviourists were significantly more likely than dog trainers to use reward-based methods. In their conclusion, the authors emphasized the need for further research, specifically exploring the guardians' understanding of the welfare implications of differing training methods and their opinions regarding the need to resort to aversive-based ones.

Concerning the differences between the perceptions of guardians of dogs born in Canada versus dogs that were imported, von Rentzell et al. (2022) surveyed 803 dog guardians and, among other things, asked about their use of harsh or gentle training methods. They found that guardians of Canadian-sourced dogs reported using harsher training methods more frequently. Moreover, guardians of Canadian dogs reported struggling more with their dog, having more regrets, perceiving more health issues, and having higher expectations for their dog. The authors suggested that guardians who acquired dogs internationally may differ in their motives and altruism, which could lead to an increase in concern for dog welfare. However, they also reported some surprising findings for further study, such as guardians of international rescue dogs reported using harsh training methods more often than guardians of non-international rescue dogs.

The authors also observed that increases in guardian age and dog age predicted a decrease in the use of harsh training methods. This same demographic of guardians reported struggling less, feeling less burdened, having fewer regrets, having lower expectations of their dogs, as well as their dogs having fewer behavioural problems and health issues. The authors proposed that older guardians may have greater financial stability, allowing them to access more resources to support building a relationship with their dog. Finally, male guardians used harsh methods more often than female guardians, and they also reported difficult behaviours in their dog more often, struggled more with their dogs, had more regret, felt less satisfied, felt less attached and were less likely to seek professional trainers when training their dogs. This suggests male guardians may be at greater risk for poorer

guardian-dog relationship outcomes. Nevertheless, these results contradict some previous findings and more research is warranted to further explore these factors.

Woodward et al. (2021) surveyed 2,154 guardians in the UK or Ireland who had puppies of less than 16 weeks, and 976 of which also completed a follow-up survey at 9 months. In these surveys, they examined the intended and actual use of different training methods at each age. A preliminary analysis indicated that at 16 weeks, 99.7% of the guardians reported the intention to use positive reinforcement and/or negative punishment, and 84.1% intended to use positive punishment and/or negative reinforcement. At 9 months, 99.7% of the guardians reported using positive reinforcement and/or negative punishment, and 74.2% used positive punishment and/or negative reinforcement. However, the authors excluded from the analyses guardians who reported using only one method from the categories of positive punishment and/or negative reinforcement. Using this classification, they concluded that at 16 weeks 15.6% of the guardians could be categorized as reward only, while 12.9% could be considered as using a mix of reward and aversive-based training. However, at 9 months, these figures climbed to 25.8% for reward only and 29.2% for reward and aversive.

The authors point out that guardians of this cohort commonly reported the use of aversive training methods as well as reward-based ones, and this was in a similar proportion to what had been observed in the survey carried out by Blackwell et al (2008). However, in this case physical punishment was much less commonly reported, with only 6.7% of guardians using this approach with their 9-month-old puppies, compared to 37% in the previous study (Blackwell et al., 2008). Moreover, that a quarter of the guardians reported using reward only training at 9 months contrasts with the results from Rooney and Cowan (2011), in which none of 53 guardians reported using only reward-based training. Regarding the characteristics of the guardians, they found that some of the factors that increased the likelihood of reporting the use of both reward- and aversive-based methods were being male, older than 55 years old, not having employment related to dogs, and not having attended a training class in the 2 months prior to completing the questionnaire. In sum, these results suggest guardian attitudes may have changed in the last decade, but there is still a need to increase awareness of optimal training approaches for dogs.

Similarly, Williams & Blackwell (2019) surveyed 630 guardians to investigate the factors that influenced their use of positive reinforcement methods to manage aggressive behaviour. They found that the perceived efficacy of positive reinforcement methods as well as the guardians' perceived ability to effectively implement them were key predictors of both current reported use and future intention of

use of these methods. Nevertheless, the authors point out that guardians were not asked about their future intentions to use other training methods, which limits the conclusions of the study and precludes the comparison of different training approaches.

Todd (2018) reviewed the barriers faced by the general public regarding the use of humane training methods. The author suggested that the differing positions of behavioural and veterinary organizations as well as trainers may give the impression that there is no consensus about which methods are better for animal welfare. Additionally, some of the factors the author identified as barriers include a lack of knowledge of the welfare risks as well as the poor quality of information available to dog guardians. In this sense, they observed that guardians usually cite themselves as the source of dog training knowledge. In many cases, guardians form these opinions based on renowned dog training books that may contain erroneous information, as well as popular dog trainers who promote the use of aversive-based techniques. Finally, the author remarked on the lack of regulations for dog trainers, which is also evident in the vast discrepancies in how this information is presented to the public, for example in the websites of dog trainers.

8. References

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Appendix 1

Summaries of the scientific literature on reward-based versus aversive-based training methods

Dog Welfare				
Study	Study type	Sample size	Task	Outcomes
Arhant et al., 2010	Survey	1276	Various	<p>More frequent P+: More aggression and excitability More anxiety and fearfulness in small dogs (<20 kg) More frequent P-: More aggression and excitability More frequent distraction with food or play (reward-based): More aggression in large dogs (>20 kg) More frequent comforting with petting or speaking (reward-based): More anxiety and fearfulness in large dogs (>20 kg) More rewards relative to total methods: Less aggression, excitability, anxiety and fearfulness</p>
Blackwell et al., 2008	Survey	192	Various	<p>P+ alone or with R+ or R-: More aggression and fear (avoidance) R+ only: Fewest problem behaviours Lowest aggression and fear (avoidance)</p>
Casey et al., 2013	Survey	3897	Various	<p>P+ or R- (compared to R+ or P-): Associated with 3.8 times greater risk of aggression between dogs in household Associated with 2.5 times greater risk of aggression towards dogs outside household</p>
Casey et al., 2014				<p>P+ or R- (compared to R+ or P-): Associated with 2.9 times greater risk of aggression towards family members Associated with 2.2 times greater risk of aggression towards unfamiliar people</p>
Casey et al., 2021	Direct observation	Total: 100 2 or more P+ methods: 50 R+ only: 50	Judgement bias test	<p>Dogs that experienced 2 or more P+ methods: Slower to go to all ambiguous locations.</p>

Dog Welfare (continued)				
Study	Study type	Sample size	Task	Outcomes
Deldalle & Gaunet, 2014	Direct observation	R+: 24 R-: 26	Sit	R- (compared to R+): More likely to display at least 1 of 6 stress-related behaviours Lower posture More mouth licking More yawning
			Walk on-leash	No difference between R+ and R-
Haverbeke et al., 2008	Direct observation	33	Various	P+ (compared to R+): Lower posture More compliant dogs displayed more stress-related behaviours
Herron et al., 2009	Survey	140	Various	P+: 40% dogs reacted aggressively to being hit, kicked or growled at 30% dogs reacted aggressively to a muzzle, forced release of item from mouth, "alpha roll", "dominance down", grabbing jowls, or stare down 10% dogs reacted aggressively to a shock collar or choke/pronged collar
Hiby et al., 2004	Survey	326	Various	More frequent use of P+, P- and R-: More current problem behaviours P+ only or with any other method: More current problem behaviours R+ only: Fewest current problem behaviours
LaFollete et al., 2019	Survey	111 military veterans with post traumatic stress disorder who had received a service dog	Various	More frequent R+: More playfulness, more active More frequent P+: More fear
Lord et al., 2020	Survey	1111	Various	Only R+: Guardian less likely to consider behaviours as problematic Combined R+ and P+, or P+ only: Increased odds for the guardian to report problem behaviours at 9 months

Dog Welfare (continued)				
Study	Study type	Sample size	Task	Outcomes
Mariti et al., 2017	Survey	906	Various	Dogs who were scolded (P+) at home for refusing treatment were reported to be more aggressive during veterinary visits
Reisner et al., 2005	Survey	1053	English Springer Spaniel	P+: 28% reacted aggressively to physical punishment 21% reacted aggressively to the threat of physical punishment 13% reacted aggressively to verbal scolding
Stellato et al., 2021	Survey	2217 complete responses Factor analysis: 1185 dogs for fear-related questions 1267 dogs for aggression-related questions	Various	P+: Use of a spray bottle as a response to unwanted behaviours during everyday life was associated with higher reported aggression scores at the veterinary clinic There were no other significant associations for reported aggression and the use of other P+ techniques in general contexts, as well as during vet visits P- (ignoring unwanted behaviours): During everyday life it was associated with lower reported aggression scores at the vet At the veterinary clinic, ignoring aggressive behaviours towards the staff was associated with higher reported aggression
Vieira de Castro et al., 2020	Direct observation	Total: 92 Aversive (>75% aversive methods): 28 Mixed (<40% aversive methods): 22 Reward: 42	Training sessions	Group Aversive More body turn, crouch, body shake, yawn and lip licking than Group Reward More yawn and lip lick than Group Mixed Lower frequency of excited state than both Group Reward and Group Mixed Lower frequency of relaxed state than both Group Reward and Group Mixed Higher frequency of tense and low states than both Group Reward and Group Mixed Higher frequency of panting than Group Reward Higher post-training cortisol levels than Group Reward Group Mixed More body turn, crouch, yawn and lip lick than Group Reward Lower frequency of excited state than Group Reward Higher frequency of tense behavioural state than Group Reward Higher frequency of panting than Group Reward No differences in baseline cortisol concentrations
		Total: 79 Aversive: 24 Mixed: 20 Reward: 35	Judgement bias test	Group Aversive Higher latency to reach all bowl locations than Group Reward No differences between Group Mixed and Group Reward, nor between Group Aversive and Group Mixed

Dog-Human Relationship				
Study	Study type	Sample size	Task	Outcomes
Deldalle & Gaunet, 2014	Direct observation	R+:24 R-:26	Sit	R- group (compared to R+ group): More gazing at guardian following verbal cue
			Walk on-leash	R- group (compared to R+ group): More gazing at guardian when walking on-leash
LaFollete et al., 2019	Survey	111 military veterans with post traumatic stress disorder who had received a service dog	Various	<p>More frequent R+: More perceived closeness More perceived attachment behaviour More eye contact More attention seeking behaviour</p> <p>More frequent P+: Less perceived closeness Less eye contact</p>
Rooney & Cowan, 2011	Mixed methods	53	Playing with guardian	P+, R- or P-: Dogs less likely to interact with a stranger
				Physical punishment: Dogs less likely to interact with a stranger and their guardian
Vieira de Castro et al., 2019	Direct observation	Total: 34 dog-human dyads Reward-based: 17 Aversive-based: 17	Ainsworth Strange Situation Test	<p>Reward-based Play: More time playing in presence of the guardian than in presence of the stranger in order 2. No difference in order 1 Following: Followed the guardian more than the stranger in order 2. No difference in order 1 Greeting: Greeted the guardian more than the stranger in order 1. No difference in order 2</p> <p>Aversive-based Play: No differences, tendency to play more in the presence of the guardian in order 2 Following: No differences, tendency to follow the guardian more in order 2 Greeting: No differences in either order</p> <p>No differences between the groups in contact-maintenance and separation-related behaviours.</p>

Training Success				
Study	Study type	Sample size	Task	Outcomes
Arhant et al., 2010	Survey	1276	Various	<p>More use of P+: Lower obedience in large dogs (>20 kg)</p> <p>More use of distraction with food or play (reward-based): Lower obedience in large dogs (>20 kg) More rewards relative to total methods: Better obedience in large and small dogs</p>
Haverbeke et al., 2008	Direct observation	33	Various	<p>Mixture of P+ and R+: Average obedience was 55%</p> <p>Incorrect response to protection work was punished more often (80%) and performance was poorer (39%); incorrect responses to obedience exercise were punished less often (60%) and obedience was better (66%)</p>
Hiby et al., 2004	Survey	326	Various	<p>P+, P- or R-: Never the most effective for any of 7 training tasks</p> <p>Lowest obedience R+ only: Highest obedience</p>
LaFollete et al., 2019	Survey	111 military veterans with post traumatic stress disorder who had received a service dog	Various	<p>More frequent R+: More trainability</p> <p>More frequent P+: Less trainability</p>
Rooney & Cowan, 2011	Mixed methods	53	Training on novel task	<p>More frequent use of P+ or P-: Lower ability to learn the novel task More total rewards during training: Better learning ability during training More frequent use of R+: Better ability to learn the novel task</p>
			Sit, lie and stay	Dogs who interacted more with their guardian during play had better obedience

Appendix 2

Summary of the scientific literature on the use of electronic shock collars

Dog Welfare					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Christiansen et al., 2001	Direct observation	Total: 114 Shocked 1 st year: 17	Hunting	Walking while exposed to sudden stimuli in 1 st and 2 nd year	In 2nd year, shocked in 1st year (compared to not shocked in 1st year) Larger discovery distance of novel stimuli Longer latency to approach unfamiliar human
Cooper et al., 2014	Direct observation	Total: 63 <i>E-collar, P+ trainer: 21</i> <i>No e-collar, P+ trainer: 21</i> <i>No e-collar, R+ trainer: 21</i>	Pet	Recall task	E-collar with P+ trainer: More tense More yawning Less interaction with environment High frequency of panting and yelping by a small number of dogs Yelping and other vocalizations more frequent with increasing shock intensity P+ trainers with or without e-collar (compared to R+ trainer): Give 2x as many verbal cues No differences in salivary cortisol between groups No differences in urinary cortisol between groups
Masson et al., 2018a	Survey	1251	Various	Reported use of e-collar in France	E-collar use and acquisition: 26% (330) of the guardians reported having used an e-collar. Out of these 11.9% used a bark-activated collar; 4.5% an electronic boundary fence and 14.2% a remote-controlled collar 75% of guardians acquired the e-collar from the internet (40%) or a pet/gardening store (35%) Satisfaction 42% (139/330) of the respondents were not satisfied after trying the EC on their dog 58 % would recommend the shock collar to others 42.8% of the guardians (57.9% of users, and 37.4% of non users) considered that shock collars were better than any other training method in solving behavioural issues Need for regulations 95.2% of non users and 77.9% of the users in favour of the implementation of regulations for the distribution 58% of the users wanted a restricted use and 14% of them even were in favour of a ban when asked about the need for regulations.

Dog Welfare (continued)					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Masson et al., 2018b	Survey	1251	Various	Reported use of e-collar in France	Physical wounds due to e-collar use (23/330, 7%): 16/149 bark-activated collar, 1/56 electronic boundary fence, 6/178 remote-controlled collar
Salgirli et al., 2012	Direct observation	Total: 42 <i>E-collar: 42</i> <i>Prong collar: 42</i>	Police	Refrain from attacking a decoy	E-collar: More vocalizations (60% vs. 23%) Maximum backward ear position – 38% Crouching – 34% Lowering of the back – 43% Prong collar: Lower body posture (no stats given) Maximum backward ear position – 64% Crouching – 47% Lowering of the back – 31%
Schalke et al., 2007	Direct observation	Total: 14 <i>Shock when touch dummy: 5</i> <i>Shock when disobey recall: 4</i> <i>Shock at random: 5</i>	Lab	Refrain from hunting a dummy	Shock at random: 328% cortisol increase Highest cortisol on '1 st day of shock + 1 st day compliant' Highest cortisol on '1 st two days of shock + 1 st day compliant' Shock when disobey recall: 160% cortisol increase Intermediate cortisol on '1 st two days of shock + 1 st day compliant' Shock when touch dummy: 31% cortisol increase Lowest cortisol on '1 st two days of shock + 1 st day compliant' No differences in heart rate between groups

Dog Welfare (continued)						
Study	Study type	Treatment & Sample size	Population	Task	Outcomes	
Schilder & van der Borg, 2004	Direct observation	Immediate e-collar effects: 32	Police & watchdog	Work training		When shocked: Lowered ears – 69%, Tongue flicking – 56%, Yelping – 53%, Avoidance – 44% Squealing – 41%, Lowered tail – 41%, Lifting front leg – 25%
		Long-term e-collar effects: 31 <i>Previously shocked: 16 Never shocked but harsh: 15</i>		Training grounds	Walk on-leash	Previously shocked (compared to never shocked): Lower ear position More lip licking
					Obedience	Previously shocked (compared to never shocked): Lower ear position More tongue flicking More lifting of the front paw
					Protection	Previously shocked (compared to never shocked): Lower ear position More lifting of the front paw More walking with completely flexed limbs
				Novel setting	Walk on-leash	Previously shocked (compared to never shocked): Lower ear position Previously shocked (training grounds compared to novel setting): Lower tail More lip licking More lifting of the front paw
		Obedience			Previously shocked (compared to never shocked): Lower ear position More tongue flicking Never shocked (training grounds compared to novel setting): More tongue flicking	
Steiss et al., 2007	Direct observation	Total: 21 <i>E-collar: 6 Lemon-scented spray collar: 8 Control: 7</i>	Shelter	Barking	No differences in activity between groups No differences in plasma cortisol between groups No differences in plasma ACTH between groups	

Training Success					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Arnott et al., 2014	Survey	812	Herding	Learn to herd	Using shock to teach herding (compared to not using shock): Less likely to retain as working dogs
Blackwell et al., 2012	Survey	Total: 579 <i>E-collar: 83</i> <i>Other aversives: 123</i> <i>Rewards: 373</i>	Pet	Recall or chasing	E-collar: Lower proportion reported success in training Rewards: Highest proportion reported success in training
China et al., 2020	Direct observation	Total: 63 <i>E-collar, P+ trainer: 21</i> <i>No e-collar, P+ trainer: 21</i> <i>No e-collar, R+ trainer: 21</i>	Pet	Recall task Sit	Note: These are the same dogs from Cooper et al., 2014 No E-collar, R+ trainer: Dogs responded significantly better to both commands after a single instruction and also had shorter response latencies than dogs from the E-collar, P+ trainer group.
Christiansen et al., 2001	Direct observation	114	Hunting	Refrain from hunting sheep	17 dogs shocked 1st yr and 12 dogs shocked 2nd yr; only one shocked both yrs
Cooper et al., 2014	Survey	Total: 63 <i>E-collar, P+ trainer: 21</i> <i>No e-collar, P+ trainer: 21</i> <i>No e-collar, R+ trainer: 21</i>	Pet	Recall task	Note: These are the same dogs from China et al., 2020 E-collar: Guardians less confident in applying the training method used with their dog No difference in magnitude of improvement between groups (92% improved)
Dinwoodie et al., 2021	Survey	963 dogs (from 800 guardians) who exhibited some kind of canine aggression	Pet	Treatment of aggression	Use of an anti-bark collar decreased the probability for successful treatment of overall aggression.
Juarbe-Diaz & Houpt, 1996	Mixed methods	Total: 9 (then 8) <i>E-collar: 8</i> <i>Citronella: 9</i>	Pet	Barking	50% reported satisfaction with the e-collar vs. 89% with citronella collar 25% reported decrease in barking with the e-collar vs. 78% with citronella collar

Training Success (<i>continued</i>)					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Masson et al., 2018	Survey	1251	Various	Reported use of e-collar in France	Effectiveness (“real behaviour modification”) Possibility to remove the e-collar after training: 25.5% (38/149) for bark-activated collar, 37.5% (21/56) for electronic boundary fence, 51.1% (91/178) for remote-controlled collar Continuous use of the e-collar: 63.1% (94/149) for bark-activated collar, 67.9% (38/56) for electronic boundary fence, 84.4% (150/178) for remote-controlled collar
Salgirli et al., 2012	Direct observation	Total: 42 <i>E-collar: 42</i> <i>Prong collar: 42</i>	Police	Refrain from attacking a decoy	No differences in learning ability between groups (93% e-collar; 76% prong)
Steiss et al., 2007	Direct observation	Total: 21 <i>E-collar: 6</i> <i>Lemon-scented spray collar: 8</i> <i>Control: 7</i>	Shelter	Barking	No difference in barking reduction between groups (<2 s by 2nd day) No difference in mean number of corrections between groups (0 by 3rd day)

Appendix 3

Summary of the scientific literature on the use of other collars and restraining devices

Dog Welfare & Training Success					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Carter et al., 2020	Canine neck model	7 types of collars varying in material, width and padding	Canine neck model (no actual dogs)	Effects of increasing forces of pulling of the leash (firm pull, strong pull and jerk)	All of the collar types had the potential to cause injury. Check chain, leather and thread collar created more pressure on the middle of the neck
Dinwoodie et al., 2021	Survey	963 dogs (from 800 guardians) who exhibited some kind of canine aggression	Pet	Treatment of aggression	Using a slip, choke, or prong collar improved fear aggression treatment according to the report of the guardians Note: The authors do point out that although punishment-based training equipment may seem effective initially, it may have negative consequences in the long term
Grainger et al., 2016	Direct observation	Total: 30 <i>Prior history with neck collar: 15</i> <i>Prior history with harness: 15</i>	Pet	Walking on-leash (both devices)	No differences in stress-related behaviours when walking collar vs. harness Dogs who usually walk on a collar had lower ear position with both devices
Kwan & Bain, 2013	Survey	129	Pet	Overall & leash-walking behaviour	Use of punishment-based collars (prong and choke): Less satisfaction with dog's overall behaviour Less satisfaction with leash-walking behaviour
Moffat et al., 2003	Direct observation	Total: 41 <i>Control only: 3</i> <i>Initially citronella: 18</i> <i>Initially scentless spray: 20</i> <i>Both types: 21</i>	Pet (<6 kg)	Barking	Citronella and scentless spray equally effective in barking reduction No effect on anxiety level with either collar

Dog Welfare & Training Success (<i>continued</i>)					
Study	Study type	Treatment & Sample size	Population	Task	Outcomes
Ogburn et al., 1998	Direct observation	Total: 26 <i>Prior history with neck collar: 26</i> <i>No history with head collar: 26</i>	Lab (random source)	Basic obedience (both devices)	<p>No differences in heart rate between collars No differences in respiratory rate between collars No differences in pupil dilation between collars No differences in plasma cortisol between collars No differences in plasma ACTH between collars</p> <p>Neck collar (compared to head collar): More unruly More leash pulling</p> <p>Head collar (compared to neck collar): More leash fighting More pawing at the nose More frequent lowering of the head More frequent lowering of the ears More frequent crouching Less looking towards the handler</p>
Pauli et al., 2006	Direct observation	Total: 26 <i>Collar: 26</i> <i>Harness: 26</i>	Sled	Pulling on a leash	<p>Collar: Intraocular pressure increased significantly from baseline (~7.4 mm Hg)</p> <p>Collar (compared to harness): Intraocular pressure increased significantly more from baseline</p>

Appendix 4

Summary of the scientific literature comparing different reward-based methods

Dog Welfare				
Study	Study type	Treatment & Sample size	Task	Outcomes
Cimarelli et al., 2020	Direct observation	Total 30 100% rewarded: 15 60% rewarded: 15	Put two paws on a target	There were no differences in learning speed
			Cognitive bias test	Partial rewarding (some clicks not followed by food presentation): Dogs in the 60% group were slower to reach the ambiguous location
Wennmacher, 2007	Direct observation	Total: 2	Spin Bow	Partial rewarding (some clicks not followed by food presentation): Negatively affected frequency, accuracy and topography of the behaviour Welfare implications Increase in noncompliance, lying down, walking away from the session and refusing to come back

Appendix 5

Summary of the scientific literature about the public perceptions about training methods

Dog Welfare				
Study	Study type	Sample size	Task	Outcomes
Daniels et al. 2022	Survey	235	Examine behaviour modification practices in the UK	<p>Guardians were just as likely to employ a dog trainer than a behaviourist They reported that both were equally able to facilitate behavior improvement, regardless of their training methods (reward-based versus combination of rewards and punishment).</p> <p>Behaviourists were significantly more likely than dog trainers to use reward-based methods</p>
Johnson & Wynne 2023	Website Analysis	100	Examine the websites of dog trainers in the US	<p>Identification of their methodology: Out of 100 trainers 56 self-identified their method in their philosophy statement, 22 were identified by the tools they used and 22 were identified via Yelp comments and reviews</p> <p>Differences in word use: Words more frequently used by non-aversive trainers: “shock collar”, “science” Words more frequently used by aversive trainers: “electronic collars”, “balanced approach”, “pack leadership”</p> <p>Demographics Reward-based trainers were significantly more likely to be certified Women were significantly more likely to practice reward-based training than males</p>
von Rentzell et al., 2022	Survey	803	Investigate differences in the guardian-dog relationship according to the dog being sourced from Canada or from outside of Canada	<p>Source of the dogs Guardians of Canadian-sourced dogs reported using harsh training methods more frequently. Guardians of international rescue dog used harsh methods more often than guardians of non-international rescue dogs Guardians of Canadian dogs reported to struggle more with their dog, have more regrets, perceive more health issues and have higher expectations for their dogs</p> <p>Demographics Increase in guardian age and dog age predicted a decrease in the use of harsh training methods. Male guardians used harsh methods more often than female guardians Guardian age and dog age were strong predictors of accessing online resources when training their dog</p>

Dog Welfare (<i>continued</i>)				
Study	Study type	Sample size	Task	Outcomes
Todd, 2018	Review	N/A	N/A	<p>Barriers to the use of humane training methods:</p> <ul style="list-style-type: none"> Disagreeing positions of animal behaviour and veterinary organizations and dog trainers may contribute to the idea that there is a lack of consensus on appropriate methods. Lack of knowledge of the welfare risks Lack of theoretical and practical knowledge of dog training Poor quality of the information available to guardians Lack of regulations for dog trainers
Williams & Blackwell, 2019	Survey	630	Various	<p>Predictors of current use and reported future intention of using positive reinforcement methods:</p> <ul style="list-style-type: none"> Perceived efficacy of the method Guardians perceived ability to effectively implement the method
Woodward et al., 2021	Survey	<p>2154 guardians in the UK or Ireland with puppies <16 weeks</p> <p>976 of them completed a follow-up survey at 9 months.</p>	Various	<p>At 16 weeks</p> <ul style="list-style-type: none"> 99.7% of the guardians reported the intention to use positive reinforcement and/or negative punishment 84.1% intended to use positive punishment and/or negative reinforcement 15.6% could be classified as reward only 12.9% could be classified as using a mix of reward and aversive-based training <p>At 9 months</p> <ul style="list-style-type: none"> 99.7% of the guardians reported using positive reinforcement and/or negative punishment 74.2% used positive punishment and/or negative reinforcement 25.8% could be classified as reward only 29.2% could be classified as using a mix of reward and aversive-based training <p>Guardian factors that increased the likelihood of using both reward and aversive-based training at 9 months:</p> <ul style="list-style-type: none"> Males Age > 55 years Not having dog related employment Not having attended a training class in the 2 months before completing the questionnaire