



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

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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 (e.g. behavioural and physiological indicators); the dog-human relationship; and training success.

After the Introduction, this document is organized into four main sections: reward-based versus aversive-based techniques; electronic shock devices; other collars and restraining devices; and hanging and helicoptering. 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
AVA	Australian Veterinary Association
BVA	British Veterinary Association
BSAVA	British Small Animal Veterinary Association
CCPDT	Certification Council for Professional Dog Trainers
CFHS	Canadian Federation of Humane Societies
CHS	Calgary Humane Society
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)
NZVA	New Zealand Veterinary Association
PPG	Pet Professional Guild

1.2. Interpretation of scientific evidence

1.2.1. Surveys

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-call '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 kneeing. 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 or situations.

2. Reward-based vs. aversive-based methods

2.1. Summary

Dog Welfare:

- 2 in 2 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
- 5 in 5 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:

- 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+

Training Success:

- More frequent reported use of P+, R- or P- was associated with lower obedience and learning ability
- 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: BC SPCA, Montreal SPCA, CHS, EHS, PEI Humane Society, RSPCA UK, RSPCA Australia, BVA, BSVA, AVA, PPG, APDT UK, APDT Australia and The Kennel Club (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 may¹ 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; Guilherme Fernandes et al., 2017) 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 have recently been 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” outcomes. He further concluded that there was no evidence to suggest that aversive

¹ 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.

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

Two 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. 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. Casey et al. (2014, 2013) conducted a survey of 3897 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 an 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 1053 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 1276 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.

Finally, 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

In addition to recording stress-related behaviours described in the previous section, Deldalle and Gaunet (2014; above) 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

Rooney and Cowan (2011; above), 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'. 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; above) 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, 2014). Similarly, the Edmonton Humane Society’s position statement on Humane Training Methods for Dogs is that they use “humane training methods that do not cause pain, fear, and/or undue stress” (EHS, 2016). 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 “only use positive reward-based training” and to “avoid harsh, potentially painful or frightening training methods.”

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, 2015). They further state that “behaviour modification through classical conditioning and/or desensitization and counter-conditioning should be performed below the threshold that would cause distress, anxiety or fear in the dog” (CVMA, 2015). The British Veterinary Association’s policy on Aversive Training Devices for Dogs states that the organization “has 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, 2016). Similarly, the British Small Animal Veterinary Association’s position statement on Aversive Training Methods is that the organization “recommends against the use of electronic shock collars and other aversive methods for training” and that it “strongly recommends the use of positive reinforcement training methods that could replace those using aversive stimuli” (BSVA, 2016). 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 animals. Negative reinforcement and positive punishment methods are not recommended” (AVA, 2014).

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 have recently 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, more than 18,000 veterinary professionals have committed to becoming Fear Free certified (Fear Free, 2017).

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 Association of Pet Dog Trainers (APDT) UK, and APDT Australia. Others have taken a more moderate

approach. For example, the International Association of Animal Behaviour Consultants (IAABC) and The Association of Professional Dog Trainers (APDT) in the USA support the LIMA (Least Intrusive, Minimally Aversive) approach to training, while the Certification Council for Professional Dog Trainers (CCPDT) in the USA supports the Humane Hierarchy. Both of these approaches prioritize the use of reward-based techniques, but allow aversive-based techniques after other, reward-based methods have failed. 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, 2017). The Kennel Club in the UK is also “against the use of any negative training methods or devices” (The KC, 2017).

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.) and Dr. Sophia Yin, founder of Low Stress Handling® (Yin, 2014).

3. Electronic shock collars

3.1. Summary

Dog Welfare:

- 3 in 3 empirical studies reported yelping and other vocalizations in response to shock
- 2 in 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 in 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 in 2 empirical studies reported no difference in cortisol between dogs trained with vs. without a shock collar
- 1 in 1 empirical study found that timing of shock delivery influenced cortisol levels

Training Success:

- 2 in 2 empirical studies found no difference in training success between shock collars vs. other aversive-based collars
- 2 in 3 surveys found lower success in training by guardians who used shock vs. other reward- or aversive-based methods; the third found no difference

Existing Standards:

- Shock collars are illegal in 9 European countries and several states in Australia
- Organizations advocating against the use of electronic shock include: CHS, Nova Scotia SPCA, RSPCA UK, RSPCA Australia, PPG, APDT, APDT UK, APDT Australia, ACVB, BVA, BSAVA, AVA, the US FDA, and the United Nations

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. The most recent study was published by Cooper et al. (2014), who 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 re-testing 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.

3.3.2. 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

Cooper et al. (2014; above), who observed three groups of dogs being trained on a recall task 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 also surveyed the dogs' guardians for overall satisfaction 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; above) 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

With regards to success in training dogs on a recall/stop chasing task, Salgirli et al. (2012; above) 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; above), 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 0 corrections by day 3.

Juarbe-Diaz and Houpt (1996) evaluated the satisfaction of eight/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 quick 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 nine European countries: Austria, Denmark, Finland, Germany, Norway, Scotland, Slovenia, Sweden, Switzerland and Wales. Legal bans are being implemented in England and Scotland. 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 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.

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, 2014); 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).

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, 2017). 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, 2017). 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.). Finally, 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).

Among North American veterinary organizations, the CVMA’s position statement declares 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). They further 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, 2015). 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.).

Internationally, the European Society of Veterinary Clinical Ethology has recently 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, 2017). 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., 2018).

The BVA's policy on Aversive Training Devices for Dogs states that "the use of devices such as electronic collars, 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, 2016); the organization is 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". The BSAVA's position statement on Aversive Training Methods states that the organization "recommends against the use of electronic shock collars [...] for the training and containment of animals. Shocks and other aversive stimuli received during training may not only be acutely stressful, painful and frightening for the animals, but may also produce long term adverse effects on behavioural and emotional responses" (BSVA, 2016). In Australia, the AVA's policy on the Use of Behaviour-Modifying Collars on Dogs states that "collars that use electric shock should not be used on animals and should be banned" and that "boundary collars must contain a mechanism that gives the animal an initial audible or visual warning (e.g. a marker tape)" (AVA, 2014). In New Zealand, the New Zealand Veterinary Association's policy on the Use of Behaviour Modifying Collars on Dogs states that the organization is "against the use of electronic shock collars as a method for the training of dogs except in exceptional circumstances", where exceptional circumstances are qualified as those "where other methods of behaviour modification have failed and euthanasia is considered the only other alternative" (NZVA, 2014). In the case of electronic boundary fences, their position is identical to that of the AVA, except that the NZVA uses the word "should" where the AVA wrote "must".

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. The UK's Animal Behaviour and Training Council, while not expressing an opinion on which devices should or should not be used, does state that shock collars are "pieces of equipment that [...] work on instilling anxiety or fear in the dog to make it behave" (ABTC, n.d.).

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 2016, the US Food and Drug Administration announced a proposal to ban electrical stimulation devices from being used on human patients in attempts to stop them from engaging in self-injurious or aggressive behaviour. The proposed ban states that “evidence indicates a number of significant psychological and physical risks are associated with the use of these devices, including depression, anxiety, worsening of self-injury behaviors and symptoms of posttraumatic stress disorder, pain, burns, tissue damage and errant shocks from a device malfunction” (FDA, 2016). Similarly, in 2013, the United Nations published a report on “torture and other cruel, inhuman or degrading treatment or punishment” in which they call upon all states to “impose an absolute ban on all forced and non-consensual medical interventions against persons with disabilities, including the non-consensual administration of psychosurgery, electroshock and mind-altering drugs” (UN Human Rights Council, 2013).

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 in 1 survey found that guardians who used prong and choke collars reported lower satisfaction with their dogs' overall behaviour and leash-walking behaviour
- 1 in 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 in 1 empirical studies found evidence of poorer welfare with neck collars than harnesses
- 1 in 1 empirical studies found higher intraocular pressure with neck collars than harnesses
- 1 in 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: CHS, RSPCA UK, RSPCA Australia, RSPCA South Australia, the Canadian Advisory Council on National Shelter Standards, CVMA, ACVB, ABTC, APDT UK, and APDT
- Organizations advocating against the use of anti-bark collars other than shock collars include 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

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

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, 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. In Toronto, an amendment to the Toronto Municipal Code initially prohibited 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. The Council was said to revisit the issue and report back on its final decision on 18 September 2017; however, I have not been able to find any updated information on this issue.

Among the animal protection organizations, CHS (2014), 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 (2013), which was gathered 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, 2015). In the United States, the ACVB also opposes the use of prong and choke collars for basic obedience (ACVB, n.d.). The ABTC in the UK does not express an opinion on which devices should or should not be used, but it does state that choke chains and prong collars are "pieces of equipment that [...] work on instilling anxiety or fear in the dog to make it behave", while choke collars are "outdated" (ABTC, n.d.).

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, 2017). 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).

With regards to the use of anti-bark collars other than shock collars, 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 states that "collars that use citronella (or other nontoxic substances) are not recommended" (AVA, 2014). In contrast, the NZVA's policy on Use of behaviour Modifying Collars on Dogs states that although "the use of behaviour modifying collars [...] should be considered only where other methods of behaviour modification have failed and euthanasia is considered the only other alternative", "if negative reinforcement is deemed necessary, the first preference should be for vibrating or citronella collars" (NZVA, 2014).

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, n.d.). 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, 2017).

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, 2014). 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 Australian Association of Professional Dog Trainers fully recommends head collars (specifically, the Gentle Leader®), stating that it offers a "fast, gentle and effective way to control unwanted behaviour" and that is "scientifically designed to work with your dog's natural instincts" (AAPDT, n.d.). The CVMA recommends the use of head halters over the use of prong or choke collars (CVMA, 2015).

RSPCA South Australia, on the other hand, 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 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.).

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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)</p> <p>More frequent P-: More aggression and excitability</p> <p>More frequent distraction with food or play (reward-based): More aggression in large dogs (>20 kg)</p> <p>More frequent comforting with petting or speaking (reward-based): More anxiety and fearfulness in large dogs (>20 kg)</p> <p>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)</p> <p>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>
Deldalle & Gaunet, 2014	Direct observation	R+: 24 R-: 26	Sit	<p>R- (compared to R+): More likely to display at least 1 of 6 stress-related behaviours Lower posture More mouth licking More yawning</p>
			Walk on-leash	No difference between R+ and R-
Haverbeke et al., 2008	Direct observation	33	Various	<p>P+ (compared to R+): Lower posture More compliant dogs displayed more stress-related behaviours</p>

Dog Welfare (continued)				
Study	Study type	Sample size	Task	Outcomes
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
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

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
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

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)</p> <p>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</p> <p>R+ only: Highest obedience</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</p> <p>More total rewards during training: Better learning ability during training</p> <p>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
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</i> <i>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</i> <i>Lemon-scented spray collar: 8</i> <i>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
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	E-collar: Guardians less confident in applying the training method used with their dog No difference in magnitude of improvement between groups (92% improved)
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
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
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
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)	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 Neck collar (compared to head collar): More unruly More leash pulling 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
Pauli et al., 2006	Direct observation	Total: 26 <i>Collar: 26</i> <i>Harness: 26</i>	Sled	Pulling on a leash	Collar: Intraocular pressure increased significantly from baseline (~7.4 mm Hg) Collar (compared to harness): Intraocular pressure increased significantly more from baseline