Pet Friendly Practice:
Emerging Evidence Bases for Investigating and Mitigating Dog Fear during Veterinary Care

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Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Petra Tamar Edwards

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Abstract

Routine veterinary care is integral for companion dog welfare, although many dogs become fearful during their veterinary visits. This poses serious risk of injury to veterinary professionals, and severely inhibits accurate diagnoses as the physiological and behavioural signs of fear and distress can appear very similar to those of pain and illness. Guardians (owners) of dogs fearful of veterinary settings can also become stressed thinking about attending the clinic and may delay seeking help. While dog experience within the veterinary context is an emerging field, little is known about how the fear of the veterinary clinic develops, the efficacy of strategies recommended to reduce stress, or the attitudes of the veterinary industry themselves in implementing such strategies. This thesis used a combination of research methods and study designs to investigate these components of a dog's veterinary experience. The findings of Chapter 2 indicate that fear of the veterinary clinic is widespread among the companion dog population. Up to 14% of dogs are reported to show severe or extreme fear when examined by the veterinarian from a global sample of 26,555 responses to the dog behaviour survey C-BARQ. Moreover, the demographics investigated in Chapter 2 contributed up to 7% of the variation of fear observed. That is, fear of the veterinarian likely develops from environmental and interaction-based factors. In Chapter 3, the behavioural and physiological responses of 35 healthy, privately owned dogs (of mixed sex, breed and age) undergoing a standardised physical examination in a mock veterinary setting were investigated. Dog heart rate increased significantly from baseline in the 'consultation' room, and also varied significantly across different steps within the physical examination. Similar results were observed for the same dogs undergoing another routine aspect of veterinary care – nail trims – in Chapter 4. Guardians reported nearly one third of dogs required nail trims two to five times per year, and the same proportion of dogs tested had also experienced a painful trim in the past. The behaviours and heart rate observed are likely to be much more extreme in a real veterinary clinic, and suggest routine

aspects of care in healthy dogs may be stressful. Chapter 4 offers a novel contribution to the literature and highlights the scarcity of peer-reviewed evidence on common aspects of dog care, such as nail trims. However, focusing on the dog's veterinary experience alone only addresses part of the issue. Chapter 5 explores the attitudes of veterinary professionals toward stress reducing veterinary care and the barriers to implementing such strategies in daily practice. Australian veterinary professional attitudes to stress reducing veterinary care are generally positive in nature, and one in five veterinary professionals who participated in the survey reported they had a stress reducing veterinary care certification. Yet many report work-related barriers to implementing stress reducing veterinary care in daily practice. Chapter 6 summarises the research findings within this thesis and provides critical considerations for future research for the continual improvement of companion dog welfare in the veterinary context.

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Dedication

This thesis is dedicated to:

Mim

- For introducing me to animal behaviour 20 years ago. I'm so glad we are able to celebrate my completion of this particular chapter together.

Nanna Tamar and my new niece Michaela

- My feminist inspiration from the past and my humanist hope for the future

Gus 'The Goodest Boi' (2014-2020)

- I miss you desperately, but know how lucky I was to have a heart dog who created such a defining chapter in my life, with such vibrant, brilliant memories that mark the start of our family. Thank you for always putting your trust in me, even as you became scared of the vet at the end.

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Chapter 2

Edwards, P. T., Hazel, S. J., Browne, M., Serpell, J. A., McArthur, M. L., & Smith, B. P. (2019). Investigating risk factors that predict a dog's fear during veterinary consultations. *PLoS One*, 14(7), 1-18. Doi: https://doi.org/https://doi.org/10.1371/journal.pone.0215416

Chapter 3

Edwards, P.T., Smith, B.P., McArthur, M.L., & Hazel, S.J. (2022). At the heart of a dog's veterinary experience: Heart rate responses in dogs vary across a standard physical examination. *Journal of Veterinary Behavior*, Vol 51, 23-34. https://doi.org/10.1016/j.jveb.2022.03.003

Conference abstracts

International Society of Applied Ethology

Developing animal behaviour and welfare: Real solutions for real problems

Edwards, P. T., Smith, B. P. McArthur, M. L., & Hazel, S. J. (2021) Heart rate responses in dogs vary across steps of a standard physical examination in a mock veterinary setting. (Virtual conference)

- Presented as a poster

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International Society of Anthrozoology

The changing nature of human-animal relationships: Theory, research and practice

Edwards, P. T., Smith, B. P. McArthur, M. L., & Hazel, S. J. (2021) Australian veterinary industry's attitude toward fear-free veterinary care for companion dogs. (Virtual conference)

- Presented as a short oral presentation

Australian Veterinary Association

Edwards, P. T., Smith, B. P. McArthur, M. L., & Hazel, S. J. (2021) Investigating fear-free veterinary care in Australia

- Presented as a short oral presentation

Pet Professional Guild (Industry)

Edwards, P. T., Smith, B. P. McArthur, M. L., & Hazel, S. J. (2021) Investigating fear-free veterinary care in Australia

- Presented as an oral presentation

Thesis aims

This thesis aimed to investigate how dog's experience their veterinary care and strategies to mitigate stress or fear in the veterinary context. The individual aims of each research chapter were:

1. Identify the prevalence of fear in dogs in the veterinary context from a large global sample, and investigate the demographic related risk factors associated with dogs who display fear at the veterinary clinic.
2. Identify the behavioural and physiological responses of dogs undergoing a standardised physical examination in a mock veterinary setting.
3. Identify the behavioural and physiological responses of dogs undergoing a common aspect of routine veterinary care (nail trims) in a mock veterinary setting, and gain a greater understanding of guardian routines of nail maintenance in their dogs.
4. Investigate the attitudes and barriers of implementing fear free veterinary care in the Australian veterinary industry.

Thesis summary

This PhD research explores how dogs experience their veterinary care and investigated industry attitudes to implementing strategies to reduce fear or distress in the veterinary context. This thesis is presented as a combined thesis by publication and conventional format. As such, reference formatting and spelling (e.g. US-based) varies throughout this thesis, and each chapter contains its own reference list, with a final reference list for the discussion. The status of each chapter at the time of thesis submission is indicated in the ‘statement of authorship’ form at the beginning of each chapter. A summary of each chapter is presented below.

Chapter 1

This chapter provides a review of the literature of dog experience in the veterinary context, and builds on existing review literature by highlighting the complexity of the dog’s veterinary experience, and the different stakeholders involved. It also summarises the current recommendations for reducing fear and distress during veterinary visits listed by stakeholder responsibility, and emphasises the importance of considering the veterinary industry capacity to implement change when investigating ways to mitigate fear or stress. Chapter 1 provides clear rationale for this body of work, including the structure for the remaining research chapters.

Chapter 2

The number of dogs that become fearful or distressed during their veterinary care is not well understood. Anecdotally, many dogs are fearful, but this has yet to be adequately quantified. To help provide some insight into this issue, the prevalence and potential demographic causes of fear of the veterinary clinic were investigated with a large, global sample of 26,555 guardians who reported how their dog responded to aspects of veterinary care using a validated, Canine Behaviour and Research Questionnaire (C-BARQ). Around one in seven guardians report their dog shows severe or extreme fear when examined by a veterinarian, and nearly 40% show some sort of fear in the veterinary context. Only approximately 7% of the variation of the total fear observed when examined by a veterinarian was due to the cumulative impact of demographic factors analysed (e.g. breed group, weight, source of acquisition.).

Chapter 3

The previous chapter highlighted that many dogs are fearful of the veterinary clinic. In order to test the level to which dogs show fear, the behavioural and physiological responses of dogs to a standardised physical examination in a mock veterinary setting were explored to investigate the role handling and examination plays in fear of the veterinarian. Heart rate (heart rate) data of 30 healthy companion dogs in South Australia were collected throughout a standardised physical examination and behavioural signs of fear or stress were video recorded. Heart rate increased significantly from the baseline measurement in the waiting room to the consult room, and varied significantly through different steps of the physical examination. For instance, the 'teeth' check had the lowest average heart rate and the pats and fake vaccination had the highest. Increasing heart rate was correlated with some behavioural signs of fear suggesting the physiological arousal was due to a negative affective state.

Chapter 4

Fear of the veterinarian is often explored within a veterinary context, yet there are other aspects of handling for routine care (e.g. nail trims) in companion dogs that may also contribute to a fearful response at the veterinary clinic. An exploratory study into a dog's physiological and behavioural responses to a standardised nail trim procedure was conducted in a mock veterinary setting. This represents one of the first studies investigating nail trims in companion dogs. Nearly a third of dogs had experienced a painful nail trim in the past, and guardians were often the ones to trim their dog's nails, or they outsourced the care to other animal professionals including veterinarians and groomers. Heart rate increased significantly during the nail trim in comparison to baseline, and increasing heart rate was also (positively, moderately) correlated with the proportion of time a dog spent with their ears back (a behavioural sign of fear). Fifteen dogs failed at least one step of the nail trim procedure due to behavioural escalation to aggression or excessive struggling, which potentially poses significant risk to guardians or other animal care professionals conducting nail trims without sufficient training or experience.

Chapter 5

One of the most important factors to mitigating fear and stress in the veterinary context is the attitude of the veterinary staff towards implementing strategies to reduce fear, as well as their perceived ability to do so. As such, the attitudes of the Australian veterinary industry toward stress reducing veterinary care (or low stress handling) was explored, and what they felt the barriers to implementation were. A total of 291 veterinary professionals (e.g. veterinarians, veterinary nurses, and other staff – managers, receptionists, kennel attendants) responded to an online survey. Approximately one in five professionals held a certification for fear-free or low stress veterinary care. Content analysis of responses to barriers to implementation revealed themes that centred on: workplace and practice management (namely – a lack of time), colleagues, clients, clinic environment, work-specific conflict, personal abilities and patients.

Chapter 6

Chapter 6 wraps up the thesis by providing a general discussion of the experimental chapters. Overall, the findings and implications of this thesis highlight that dogs becoming fearful of their veterinarians is largely due to factors outside the dog's control – larger contributors of fear are likely environmental or handling-based in nature. Standardised physical examinations and nail trims can be stressful for dogs and that the behavioural and physiological responses observed in this study would likely be more extreme in a real veterinary clinic. Stress reducing veterinary care certifications may help in mitigating fear of the veterinary clinic, but mitigating fear and stress in the veterinary clinic is not as simple as having a certificate. Fear of veterinary care is a complex field of research and a more holistic approach into investigating and improving animal welfare in the veterinary context than has been employed traditionally is needed. Further investigation should include the dog's experiences in handling and interaction practices that occur outside of the veterinary context (e.g. grooming procedures that may occur at home), as well as how fear of the veterinarian develops, the efficacy of stress reducing veterinary care techniques, and how they can be implemented by staff and guardians effectively and easily in daily practice.

Chapter 1

Fearful Fido: Investigating dog experience in the veterinary context to reduce distress

Introduction

Routine veterinary care is integral for companion dog welfare, although investigation into how dogs experience their veterinary care or strategies used to mitigate stress or fear are still emerging. This chapter summarises the status of the current literature on the experience of dogs during veterinary visits, discusses factors that may influence the veterinary experience, highlights the stakeholders involved and their responsibilities and finally, concludes by emphasising the importance of veterinary professional engagement in strategies to reduce dog distress.

Statement of Authorship

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Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Abstract

For many dogs, receiving veterinary care can be a stressful, fearful or traumatic experience. However, understanding and improving the veterinary experience for dogs is challenging due to the dynamic nature of the veterinary visit, the number of stakeholders involved (veterinarian, guardian and dog), and the perception and prior experience of the dog. The majority of recommendations for reducing stress typically fall to either the owner or the veterinarian and involve changes to management or active training and counter-conditioning practices. While many recommendations to reduce fear or distress during veterinary visits are readily available, appear common-sense in nature, and are anecdotally successful, overall evidence of their efficacy is lacking. Further, it is not enough to simply identify strategies designed to reduce distress in the veterinary context; investigating ways in which they can be efficiently and successfully implemented is integral to the continual improvement of dog welfare in the veterinary industry. In this review, we summarise the current literature relating to companion dogs' experience during veterinary visits, and explore the factors influencing that experience. We conclude by providing a summary of the recommendations available to reduce stress within the veterinary context, categorised by stakeholder responsibility, and highlight potential areas for future research.

1.1. Introduction

The Australian veterinary industry services millions of companion animals each year, including 4.8 million dogs (AMA 2016). However, attending the veterinary clinic can be stressful for companion animals and their owners (guardians). For instance, in an American cohort of 2,188 dog and cat guardians, 58% of cat guardians and 38% of dog guardians believed that their companion animal 'hates' going to the veterinarian, and 38% of cat guardians and 26% of dog guardians found it stressful just thinking about taking their dog or cat to the veterinary clinic (Volk et al. 2011). Stress during veterinary visits is counterproductive for a number of reasons, including: the negative impact of stress on long-term health; how frequently a guardian brings their dog to the veterinarian; the veterinarian's ability to accurately diagnose health concerns; and, stressed dogs can place veterinarians at greater risk of injury (Frank 2014; Gregory 2004; Moffat 2008; Overall 2013; Volk et al. 2011). Thus, reducing distress during veterinary visits could significantly improve patient and staff welfare within the veterinary industry.

Strategies to ameliorate animal stress within the veterinary context are emerging as the industry becomes aware of the value of low stress handling, and fear-free techniques that promote companion-animal-friendly practice (Overall 2013; Yin 2009). As a timely contribution to this field, we seek to explore the most recently proposed approaches relating to the veterinary experience for companion dogs; summarise the current strategies recommended for reducing stress, and stimulate discussion on the viability of such interventions being successfully implemented within the veterinary industry. We argue that strategies to ensure 'fear-free' veterinary visits are essential in promoting and modelling high standards of animal care and welfare within the veterinary community.

1.2. The Dog's Veterinary Experience

Every dog requires veterinary care during their lifetime, and every dog will experience these veterinary visits differently. From the dog's perspective a 'routine' veterinary visit encompasses walking into a strange place with slippery surfaces, being surrounded by strange sounds, sights, smells, and potentially stressed animals (Hewson 2014), and then being handled or restrained, while potentially enduring painful or invasive procedures. Current estimates of the proportion of dogs that display physiological or behavioural signs of fear or stress during veterinary visits range between 10% and 78.5% (Table 1). However, it is difficult to determine the true nature and degree of the impacts given that assessments of the dog experience at the veterinary clinic utilise different physiological, behavioural or qualitative measures of stress, in different locations within a single clinic, and under different conditions (Table 1). In relation to behavioural measures, for instance, Stanford (1981) categorised dogs as 'friendly' or 'aggressive' as they entered the clinic from observed behavioural measures and their willingness to enter, while Doring et al. (2009) studied fear based on the dog's willingness to approach, interact, take food or play in the waiting room, exam room, and upon exiting the clinic. Vaisanen et al. (2005) investigated stress in solitary and confined kennel conditions using behavioural and physiological measures, while Godbout et al. (2007) recorded behavioural measures of stress in puppies during a mock exam. Although the studies in Table 1 provide a greater understanding of how dogs can experience their veterinary care in different clinical contexts, their varied approaches make comparison difficult, and estimates of the proportion of dogs that experience distress or fear during their veterinary visits remain tentative. In future investigations, a more consistent approach regarding testing location within the clinic, who collects the measurements (e.g. researcher, veterinary staff or other dog professional, or guardian) and how they are collected, as well as a combination of behavioural and physiological signs of stress would be beneficial in gaining greater insight into the dog's perception of their veterinary care.

1.2.1. Perpetuating Negative Experience

Negative experience begets negative experience. Previous negative experience during a veterinary visit increases fearfulness in the current visit, even if that current experience is a neutral or positive one (Doring et al. 2009). While some studies have shown no significant increase in physiological or behavioural signs of stress relating to testing order (first or second visit; Csoltova et al. 2017), or with the number of visits for chronically ill dogs (Nicholson & Meredith 2015), these examinations were routine veterinary care without painful interactions. Perhaps then, the emphasis should be placed on severity of negative experience (from the dog's perspective) in a veterinary setting, instead of simply the number of visits. Further, Casey et al. (2014) identified that aggression tends to be context-specific, which is supported by the differences in aggressive responses in one context (e.g. unfamiliar people) but not others (e.g. familiar people or dogs) (Farhoody et al. 2017; Hsu & Sun 2010). Therefore, it is likely distress follows similar context dependency. Distressed dogs during veterinary visits are learning to associate that negative emotional state with the veterinary clinic and/or staff, as well as learning to *anticipate* those negative experiences or pain in the same context next time (Overall 2013). As such, preventing negative experience in the first place becomes an increasingly critical area of investigation and priority for intervention.

Table 1: Studies investigating how dogs experience the veterinary clinic (chronological order)

Author	Study Design	Proportion of adverse experience during veterinary visit	Measurement(s) used
Stanford (1981)	Cross-sectional, observation (N=462, any breed, age, sex)	▪ 70% enter clinic unwillingly	▪ Behavioural observation upon entrance to clinic, subjective categorisation
Vaisanen et al. (2005)	Cross-sectional, observation (N = 41, any breed, female)	▪ 30% stressed while confined without guardian, 70% stressed at least some of the time	▪ Behavioural observation (recorded) while dog alone in cage ▪ Heart rate and heart rate variability ▪ Response to human approach
Mills et al. (2006)	Cross-sectional, triple blind, placebo controlled (N=15, any breed, sex, age, neuter status, fearful of veterinary clinic)	▪ Inclusion criteria specified dogs must have been fearful of the veterinary clinic for at least one year. ▪ Waiting room: Dogs appeared more relaxed and less anxious when Dog Appeasing Pheromones (DAP) was used. No significant difference in recorded behaviour between treatment groups (DAP and Placebo). ▪ Consult room: Dogs were more relaxed and less anxious when exposed to DAP.	▪ Behavioural observation and subjective profiling of emotional state from mutually exclusive definitions ('relaxed', 'aroused', 'anxious') in waiting room and consulting room from 2 blinded observers with high correlation. ▪ Guardian present but asked to interact as little as possible with their dog
Godbout et al. (2007)	Cross-sectional, observation (N = 102, any breed, sex, puppies only 8-16wks)	▪ 10% show extreme avoidance behaviour (8-16weeks), prior to being handled during a mock-exam	▪ Behavioural observation (recorded) in response to different aspects of veterinarian examination in treatment room ▪ Guardian removed from test
Hernander (2008)	Cross-sectional, observational (N= 118, any breed, age, sex)	▪ Entering clinic: 29% obviously tense, 1.8% extremely stressed ▪ While waiting: 11% obviously tense, 1.8% extremely stressed	▪ Observer reported scale, while in waiting room

		▪ While being weighed: 27% obviously tense, 3% extremely stressed	
Doring et al. (2009)	Cross-sectional, observation (N=135, any breed, sex)	▪ 78.5% dogs fearful ▪ Previous negative experience resulted in increased stress during the current experience ▪ Males were significantly less fearful than females	▪ Behavioural observation (checklist) of entrance into treatment room, in treatment room, during examination and leaving treatment room ▪ Guardian-reported survey
Kim et al. (2010)*	Placebo control and double blind study (N= 43, any breed, age, sex)	▪ Overall reduction in separation related behaviour identified in DAP (dog appeasing pheromone) group ▪ Reductions in elimination, excessive licking and pacing in DAP group	▪ Behavioural observations of selected separation related behaviours by multiple observers

Volk et al. (2011)	Exploratory, qualitative (64 companion animal guardians)
	Online Quantitative survey (2,188 companion animal guardians)
		▪ Dog guardians report:
		  ▪ Wouldn't take their dog to the veterinarian if a vaccination wasn't needed (33%)
		  ▪ Would only take dog if it's sick (24%)
		  ▪ Just thinking about the visit is stressful (26%)
		  ▪ My dog hates going to the veterinarian (38%)
			▪ Guardian reported survey and focus groups

Hekman, Karas and Dreschel (2012)	Cross-sectional (N=28, any age, sex, breed)	▪ 32.1% showed HSC (high salivary cortisol) ▪ Panting and lip licking positive correlation with high salivary cortisol (HSC) ▪ 100% of dogs in HSC observed panting at least some of the time ▪ 79.8% of observation time panting (HSC) cs. 38.5% of observation time panting (low salivary cortisol)	▪ Behavioural Observation (recorded) and ethogram ▪ Physiological measures – salivary cortisol
Mariti et al. (2015)	Cross-sectional, observation (N= 45, any breed, sex)	▪ 60% dogs stressed in veterinary clinic (guardian reported)	▪ Behavioural observation (recorded)

		▪ 28.9% dogs high stress in waiting room (guardian and behaviourist observed) ▪ 53% dogs showed four or more signs of stress (other than panting)	▪ Guardian & veterinary behaviourist reported evaluations of stress levels in waiting room
Bragg et al. (2015)	Prospective, observational (N = 30, any breed, sex, all neutered)	▪ Significant increases found between home and veterinary clinic measurements of pulse rate (11%), rectal temperature (<1%) and blood pressure (16%) ▪ Panting observed at veterinary clinic (63%) significantly higher than dogs observed panting at home (17%)	▪ Respiratory Rate, pulse rate, rectal temperature, systolic arterial blood pressure
Csoltova et al. (2017)*	Randomised within-subject crossover design (N = 33, any breed, any sex)	▪ Dogs became significantly more stressed when examined in comparison to pre-examination ▪ Dogs with guardians that positively interacted with them showed fewer signs of stress	▪ Behavioural observation (recorded) ▪ Salivary cortisol, heart rate monitoring, rectal temperature, maximal ocular surface temperature
Engler and Bain (2017)*	Prospective randomised control study (N= 74 dogs, breed, age, sex unknown)	▪ Guardian reported dogs as less anxious when in an exam room with classical music ▪ Guardian reported higher satisfaction when exposed to classical music	▪ Guardian reported survey
Lind et al. (2017)	Cross-sectional, observation (N=223, any breed, sex)	▪ Significantly more dogs were more playful and more likely to take a treat outside the clinic than inside	▪ Behavioural tests – social contact, play and treat inside and outside veterinary clinic ▪ Evaluations of stress provided by guardian, test leader (waiting room), veterinary nurse and veterinarian (treatment room) ▪ Guardian-reported questionnaire

*Current studies that have tested the efficacy of a stress-reducing intervention, used within the table to inform distress prevalence data

1.3. What is Stress?

An animal’s stress response is an evolutionary adaption that exists to increase the chances of survival from threats (or perceived threats). Likewise, fear serves as an adaptive emotional response to a perceived threat. For the purposes of this review, stress is defined as “a response [that] consists of physiological, behavioural and psychologic changes that occur in the face of a challenge to an individual’s well-being” (Mills, Karagiannis & Zulch 2014, p. 525). Given that stress has been covered elsewhere in more depth (Beerda et al. 1996; Gregory 2004; Mills, Karagiannis & Zulch 2014; Moberg 2000), we only cover this briefly. Both Moberg (2000) and Gregory (2004) agree that the stress response relies solely on the animal’s perception of the stressor (the stimulus causing the stress). That is, the *perception* of a threat evokes the stress response, regardless of danger in reality. As such, strategies to reduce stress will be most successful where they can be adapted for each dog’s unique perception and experience.

1.3.1. Measuring Stress

Biological measures of stress include stress hormones (e.g. cortisol) found in levels proportionate to the severity of the stress. Previous studies in dogs have measured stress via cortisol levels in saliva, urine and hair, and other physiological measures including heart rate, rectal temperature, blood pressure, pulse rate, and maximal ocular surface temperature (Beerda et al. 1996; Beerda et al. 1998; Beerda et al. 2000; Bennett & Hayssen 2010). The use of salivary cortisol as a measure of physiological stress needs to be considered and collected carefully, under strict experimental conditions due to the individual and environmental variability inherent in salivary cortisol samples (Cobb et al. 2016). This makes comparison across research using physiological stress measures under varied conditions difficult. In addition to this, inferring levels of stress solely from physiological responses is difficult as biological arousal alone is not synonymous with negative emotional state. As such, behavioural measures are also commonly used in investigations of stress (Beerda et al. 1998; Beerda et al. 2000; Hekman, Karas & Dreschel 2012; Mariti et al. 2015), and are discussed in more detail later in this section. Examples of ethograms of such behaviours can be found in Doring et al. (2009) and Csoltova et al. (2017), and are also comprehensively covered by Lloyd (2017). Measures of stress used to investigate experience within a veterinary context (summarised in Table 1) include: salivary cortisol, heart rate, rectal temperature, maximal ocular surface temperature, respiratory rate, and blood pressure, as well as behavioural signs such as response to human approach or interaction and willingness to enter the waiting or consult room.

From a behavioural perspective, a dog's stress or fear response to a perceived threat (e.g. a veterinarian approaching or routine check) can be categorised as either passive or active. Passive responses can include: crouching, sitting, tail between legs, rolling onto their back, or simply remaining still (Overall 2013). The "absence of a signal can function as a signal itself" (Overall 2013, p.150), and as such, remaining still is of significant importance when assessing stress levels in patients. Passive in-patient stress may affect the dog's ability to urinate or eat, or the ability to move them easily (Hewson 2014). Conversely, active responses in dogs involve more emphatic attempts to evade the perceived threat, and can include piloerection, snarling, or other agonistic behaviours. Behaviours will increase in intensity from more subtle signs of distress (also known as displacement or fiddle behaviours such as lip licking) to growling, biting, and snapping depending on the level of distress and individual responses of the dog (Lindsay 2001; Moffat 2008; Overall 2013; Shepherd 2009). Examples of this escalation from passive to more active behavioural responses are clearly depicted in the 'Ladder of Aggression' (Shepherd 2009). Active stress responses can also impact on patient welfare and risks to staff via aggression, disruptive behaviours (e.g. barking) or destructive behaviours (e.g. chewing through dressings; Hewson 2014).

Guardian-reported scales have also been used as a subjective measure of stress within the veterinary context. Some studies suggest guardians are able to accurately identify overt signs of stress in a waiting room context (Lind et al. 2017; Mariti et al. 2015), although they may miss some of the more subtle signs of stress (Mariti et al. 2012; Mariti et al. 2015). Mariti et al. (2012) also identified that only 59% of guardians accurately considered stress to have both short- and long-term consequences that may lead to illness. Unlike Mariti et al. (2015) who identified dog guardians and behaviourists tend to have a high agreement of extreme stress behaviours, Lind et al. (2017) found that dog guardians tended to rate their dog as less stressed than veterinary staff. However, this latter discrepancy may be due to the veterinary staff rating stress in the exam room where dogs appear to exhibit more stress (Csoltova et al. 2017; Doring et al. 2009; Lind et al. 2017), while guardians rated their dog's stress in the waiting room. In a non-veterinary context, Wan, Bolger and Champagne (2012) suggest those with more experience (e.g. dog industry professionals) were significantly better at identifying fear in dogs than those with less or no experience (non-dog guardians). Experienced dog professionals tended to use more physical features (e.g. eyes, ears, mouth, tail, paws) to interpret emotion from body language, and also reported lower difficulty and higher accuracy when rating 'happy' and 'fearful' examples, in comparison to those with less dog experience (Wan, Bolger & Champagne 2012). Therefore using behaviour as a guide for dog distress may not accurately reflect the reality depending on the observers; a still dog may be mistaken for being calm by observers who expect distress to involve active responses only. As such, guardian's estimates of the prevalence of distress during veterinary visits may only reflect those dogs exhibiting active stress responses and likely under-represent the reality. This illustrates a very real need for guardian (and veterinary staff) education focused on emotional interpretation based on dog body language and behaviour. Indeed, Mariti et al. (2012) reinforce the importance of guardian interpretation of (especially subtle) behavioural signs of stress as a way to intervene early and prevent escalation into distress. A standardised approach to measuring stress (both biological and behavioural) within the veterinary context would be useful for valid comparison across different studies.

1.3.2. When does stress become distress?

The physiological stress response involves the activation of biological processes that ready the animal for action, and comes at a biological cost (Moberg 2000). This cost is absorbed easily where the stress event is brief. However, frequent acute stress events, or chronic stress, can deplete biological resources to an extent that cannot be absorbed, resulting in 'distress' (Moberg 2000). Distress can reduce reproductive potential and immune function, increase risk of contracting disease, and impact negatively on lifespan and skin conditions (Carlstead, Brown & Strawn 1993; Dreschel 2010; Gregory 2004; Moberg 2000). Chronic stress in dogs during adolescence can also significantly influence behaviour and cognition as an adult, as well as perception and interpretation of unfamiliar situations, responses to aversive events and how decisions are made (Chaby et al. 2013). Distress then becomes a welfare issue in a veterinary context where the stress response is disproportionate to the reality of the threat, in cases where stress is sustained for a length of time, or where stress occurs frequently.

1.4. The Dynamic Veterinary Visit

Veterinary visits are complex due to the nature of all stakeholders involved: dog, guardian and veterinary staff (Dawson et al. 2016; Herron & Shreyer 2014; Lloyd 2017). The dynamic relationships between each stakeholder play an integral part in the success of patient care. Further, factors beyond stakeholder control need to be considered carefully during interactions with patients as they can significantly influence a dog's perception and predisposition to distress within the veterinary context, including biological or genetic attributes (breed, age, sex, neuter status), early or previous experience and learning, and the physical environment. Greater awareness of how different factors can influence distress and accumulate over time will help predict experience within the clinic and reduce patient stress.

1.4.1. Veterinarians and their Clients

The relationship between the veterinarian and their client (the guardian) will impact on patient health and experience within the veterinary context. Companion animal guardians make decisions about which veterinarian they see and how often they attend based on the fees, convenience, and how they feel about the veterinarian (Volk et al. 2011). This is especially important considering the powerful position veterinarians hold in being a credible and valuable source for guardians to discuss behavioural concerns (Roshier & McBride 2013), and the unique opportunity they have to provide advice that reduces the incidence of undesirable behaviours (Gazzano, Mariti, Alvares, et al. 2008). Guardians care about whether their veterinarian is seen to care for their dog (McArthur & Fitzgerald 2013), and communication designed to build relationships with clients is highlighted as an integral area that could improve patient welfare (Dawson et al. 2016; Knesl et al. 2016). Further, clear and thorough communication with clients can increase the likelihood of compliance at home impacting a veterinarian’s ability to provide health care to a high standard, and the loyalty of the guardian to their veterinarian (Lue, Pantenburg & Crawford 2008). Successfully reducing distress in the veterinary context must account for the way in which these factors influence the dynamic nature of the veterinary experience.

1.4.2. Veterinarians and their Patients

Health and behavioural welfare are equally important to the success of patient care. Ensuring both physical and mental wellbeing is fundamental to the duty of care of veterinarians (Heath & Wilson 2014). Preventing distress is also a priority as the behavioural symptoms of fear and anxiety (such as panting, salivation, pacing or lip licking), are similar to those for dogs presenting with nausea or neurological conditions (Frank 2014), and can impact the accuracy of diagnoses. Further, both Moberg (2000) and Gregory (2004) suggest handling and restraint can cause stress in animals – an idea supported in cattle (Grandin 1998a, 1998b). And so distress may occur at the onset of handling or restraint practices for routine veterinary care. The ability to understand and interpret species-specific behaviour then, is essential in reducing distress during veterinary visits (Dawson et al. 2016; Herron & Shreyer 2014; Lind et al. 2017; Lloyd 2017; Moffat 2008; Overall 2013; Shepherd 2009). Yet not all veterinary schools offer a formal course in animal behaviour, with 22 out of the 30 US AVMA accredited veterinary schools offering such a course (Shivley et al. 2016). An understanding of dog body-language that communicates discomfort or stress and knowing how to respond appropriately is useful in helping a dog feel safe and comfortable when being handled or during routine care (Moffat 2008; Overall 2013). Veterinarians who miss signs of fear or stress when treating patients expose themselves to unnecessary risks of injury (Moffat 2008). Every step possible should be taken to ameliorate the potential for a dog to become stressed or fearful (Lloyd 2017), and prevention is always better than a cure. Further, veterinary staff that fail to handle distressed, fearful or over-active animals in a compassionate manner risk damaging their relationship with their client (Knesl et al. 2016) and also increase the chances of an aggressive or difficult interaction with the dog next time (Overall 2013). Insight into companion animal communication, appropriate responses and understanding the ways in which behaviour influences experience and welfare needs to be adequately addressed in veterinary education and is essential in reducing distress in patients.

1.4.3. Dogs and their Guardians

The relationship between dog and guardian is critical to our understanding of how dogs experience the veterinary clinic. Guardians can help reduce a dog's stress during veterinary visits by interacting with them in a supportive and positive way (Csoltova et al. 2017), and those reporting high emotional closeness with their dogs had a greater calming effect during the veterinary exam (Lind et al. 2017). Dogs prefer their guardians over other unfamiliar individuals in situations that evoke stress or fear (Kerepesi, Doka & Miklosi 2015) and also tend to be less stressed when interacting with humans in a shelter environment than when left alone (Coppola, Grandin & Enns 2006). In contrast, Kuhne, Hößler and Struwe (2012) suggest that interaction between dogs and familiar people results in more redirection behaviour (sniffing, licking the floor, playing with inanimate objects, digging, drinking, visual scanning, excessive activity) than for unfamiliar people. Kuhne, Hößler and Struwe (2012) and Kuhne (2016) highlight that these redirected behaviours function to interrupt the social interaction briefly. However, play with inanimate objects may also be a learnt behaviour dogs perform when comfortable and relaxed around familiar people. As a result, the strength and type of relationship a guardian has with their dog may dictate how effective they will be at reducing stress during veterinary visits. Guardians reporting high attachment levels to their dogs are also more likely to attend the veterinary clinic frequently, seek preventative veterinary care and to comply with veterinarian recommendations (Lue, Pantenburg & Crawford 2008). Understanding the extent to which a guardian's presence or interaction with their dog will alleviate distress, and encouraging that interaction where beneficial, is integral to maintaining patient welfare.

1.4.4. Genetics and Biology

An animal's stress response and behaviour are influenced by their biological, physical and genetic predisposition. Overall (2013) suggests that arousal (activation of sympathetic nervous system and associated hyper-vigilant, defensive or unpredictable behaviour) is at the core of nearly all behavioural conditions, including fear. Fear and aggression are inheritable, and traits like separation anxiety, touch-sensitivity, guardian-directed aggression and dog rivalry piggyback on the same loci that code for small body size (*IGF1* and *HMGA2*; Zapata, Serpell & Alvarez 2016). Additionally, problem behaviours (e.g. touch sensitivity, urination when left alone, dog-directed fear, separation-related problems, non-social fear, guardian-directed aggression, attention seeking) tend to increase as height or body weight in dogs decrease (McGreevy et al. 2013). Similarly, smaller dogs are significantly more likely to be aggressive and excitable, and more anxious and fearful than larger dogs (Arhant et al. 2010), as well as more vocal in the veterinary clinic in comparison to larger breeds (Godbout et al. 2007). While not categorised by size, Duffy, Hsu and Serpell (2008) identified that some breeds (e.g. dachshunds, Chihuahuas, Jack Russell terriers) are more likely to exhibit aggression towards guardians and strangers than others (e.g. golden retrievers, whippets, Bernese mountain dogs). However, the causational direction of the relationship between undesirable behaviour or stress, and size is unclear. Are small dogs at the veterinary clinic more fearful because they are small, or are they fearful because their guardians treat them differently to guardians with large dogs? (Bassi et al. 2016). Further, it is likely that breeders are unknowingly selecting for adverse behavioural traits in dogs when breeding for conformation (Asher et al. 2009).

The specific roles for which dogs were bred for can also impact on their behaviour. Border collies bred from working lines were significantly more impulsive on the Dog Impulsivity Assessment Scale than working golden retrievers, while no difference was identified between the two breeds when bred from show lines (Fadel et al. 2016). Within the Gundog breed group, golden retrievers were bolder than dogs traditionally bred for pointing or flushing (Starling et al. 2013b). Modern and ancient breeds of dogs also displayed several differences in behaviour on a validated behavioural assessment questionnaire (C-BARQ) (Smith, Browne & Serpell 2017). Modern breeds also differ significantly to the Australian dingo, a wild canid, showing lower tendencies for stranger-directed aggression, non-social fear and escaping/ roaming (Smith, Browne & Serpell 2017). A dog's genetic history, both in terms of immediate hereditary lineage, and the potential long term impact of artificial selection on breed conformation and size, provide insight for veterinary staff and guardians of the dog's potential predisposition to distress within the veterinary context.

Other biological or hormonal factors (e.g. sex and neuter status) can influence a dog's experience during veterinary visits. Male dogs were significantly less stressed in a veterinary setting than female dogs (Doring et al. 2009). This is supported by other studies that identified differences in behaviour based on sex in non-veterinary contexts. In comparison to female dogs, male dogs were more likely to exhibit separation related distress (McGreevy & Masters 2008), guardian-directed aggression (Hsu & Sun 2010), and scored higher on a boldness scale (Starling et al. 2013a). Neutering was also correlated with increased guardian-directed aggression (Hsu & Sun 2010), lower boldness scores (Starling et al. 2013a) and, in female dogs, a reduced risk of aggression (Casey et al. 2014). However, Farhoody et al. (2017) found no significant associations between neutering and aggression toward familiar people or dogs, although they did identify a significant increase in aggression toward strangers in neutered dogs, and mainly those neutered between 7-12 months of age. While statistically significant due to the large sample size, there is a very small effect size, with these factors explaining less than five per cent of the total variation in aggression to strangers. As such, the extent to which sex or reproductive status influences behaviour remains controversial, but do bear consideration for future research.

A dog's age can also influence its response to stressful situations. Godbout et al. (2007) identified a small proportion of puppies displayed 'extreme' avoidance behaviours during a mock veterinary exam. Further, Godbout and Frank (2011) suggest fear responses observed in young puppies are likely to persevere into adulthood, although whether this may still be the case given appropriate interventions for fear or anxiety is unknown. In addition to this, younger dogs (less than 2 years) within the veterinary clinic exhibited significantly fewer behavioural signs of fear than older dogs (over 2 years) (Doring et al. 2009). Similar trends are seen in a non-veterinary context. In general, younger dogs are bolder than older dogs (Starling et al. 2013a), while older dogs have been associated with increased risks of aggression to unfamiliar people (Casey et al. 2014), with guardian-directed aggression (Hsu & Sun 2010), and fear of noises (Blackwell, Bradshaw & Casey 2013). Gaining insight into how age may impact on perception and behaviour will better inform guardians and veterinary staff of the likelihood of dogs exhibiting distress within the veterinary clinic.

1.4.5. Social Interaction and Previous Experience

A dog's previous experience, and the associations they have made in the past, will help to predict how they may react in similar situations in the future. Early experience can have an effect on future social behaviour and stress responses (Spencer 2017); influence emotional wellbeing (Gazzano, Mariti, Notari, et al. 2008); and provide a good foundation for future learning and training (Seksel, Mazurski & Taylor 1999). Additionally, early negative experience is likely to predict aggressive responses in the future (Wormald et al. 2016), and can impact on behaviour and cognition as an adult (Chaby et al. 2013). As such, the use of a short and simple stress scale as defined by Overall (2013) is invaluable in facilitating simple patient records to objectively measure how behaviour and stress responses change over time (Lloyd 2017). Understanding how dogs experienced their previous visits will benefit the veterinary staff working with the dog in the current visit, and better inform care plans for the future.

Training and socialisation will also impact behaviour. Attendance at puppy pre-school (i.e. socialisation classes occurring between 8 to 12-16 weeks of age) or ring-craft classes (i.e. experiential and obedience classes used to prepare dogs for breed shows) reduces the likelihood of stranger-directed aggression (Casey et al. 2014). Further, the training methods employed can impact significantly on behaviour, physiology and welfare. Punishment based training techniques (stopping unwanted behaviour through applying an aversive consequence like smacking, yelling, spray bottles, correction chains, electric shock collars, or other punitive approaches) are considered a welfare concern (RSPCASA 2018; Ziv 2017). Specifically, training that employs punishment has been associated with increases in aggression, stress, problem behaviours, reduced interaction with strangers and playfulness, lesser guardian satisfaction and a reduced ability to learn new things easily (Deldalle & Gaunet 2014; Herron, Shofer & Reisner 2009; Hsu & Sun 2010; Kwan & Bain 2013; Rooney & Cowan 2011). As such, punishment to change unwanted behaviour should not be used or recommended within the veterinary context, and veterinarians treating dogs trained with these methods should be aware the dogs may be more susceptible to experiencing distress during their care.

1.4.6. Environment

The veterinary environment will also influence a dog’s perception, and therefore the potential for their distress. What smells, sights or sounds greet them as they walk in? Simply entering a veterinary waiting room can be stressful for dogs (Stanford 1981), especially if met with 'chaos' or an overabundance of visual, audible or olfactory stimuli to process (Hernander 2008). The physical location can also influence experience. Dogs are likely more stressed at the clinic than at home (Bragg et al. 2015) and display more stress within the examination room compared to the waiting room (Csoltova et al. 2017; Doring et al. 2009; Lind et al. 2017). Stress varies even within the examination room – dogs treated on exam tables exhibited more stress than dogs treated on the floor (Doring et al. 2009). Indeed, Dawson et al. (2016) suggest that physical attributes of the environment, like surface area, and auditory or visual stimulation, can significantly influence stress levels for dogs during a veterinary visit. Further, unpredictable stressors have been significantly associated with increased physiological stress responses in comparison to predictable stressors (Beerda et al. 1998). Likewise, control over outcomes results in a significantly greater positive emotional state (McGowan et al. 2014). Therefore, veterinary visits should follow the same routine every time a dog attends wherever possible, and allow the dog as much control as possible over interactions, entrances, exits and participation in health care. The physical features of the veterinary clinic environment, from the waiting room and treatment area to colours used for furniture or on walls may also influence a dog's experience (Dawson et al. 2016;Overall 2013). Dogs see differently to humans (Miller & Murphy 1995; Pongracz et al. 2017), and differences in perception of brightness, colour and acuity should be taken into account for veterinary clinic design. Greater insight into how dogs perceive and experience the veterinary environment will assist in developing strategies to ameliorate stress during veterinary care.

1.4.7. The Trigger Stacking Effect

While impacting on experience and predisposition to stress in and of themselves, the factors (stressors) previously described can interact to provide a cumulative stressor effect. Physiological stress responses like plasma and saliva cortisol can remain significantly elevated from baseline for between 30-90 minutes and 20-105 minutes post-stressor respectively

(Beerda et al. 1996). In addition to this, Dickens, Delehanty and Romero (2010) suggest that the translocation of wild animals involves four main stressful components (capture, captivity, transport and release), which accumulate to cause chronic stress. These components also mirror many aspects of taking companion dogs to the veterinary clinic. As such, each stressor perceived by the dog in quick succession, is likely to 'stack up' as the physiological stress response fails to return to normal in between the arrival of each stressor (Overall 2013). This trigger stacking effect can impact greatly on the dog's quality of experience within the veterinary clinic. For instance, if a dog finds harnesses, leads or collars attached (capture), car rides (captivity/ transport), being around other dogs (release/ arrival at veterinary clinic) and having his nails clipped stressful but can tolerate each circumstance individually, their cumulative stressor impact when they occur within a short space of time at the veterinary clinic may result in distress (Figure 1). That is, each event individually may have a level of stress associated with it. Yet when all events occur together within a short space of time, the triggers stack up and result in distress. Further, as *perception* of the stressor influences stress (Gregory 2004; Moberg 2000), the threshold at which distress occurs will differ for each dog. This then requires the dog's welfare and emotional state to be assessed and reassessed anew both within each stage of the visit and between visits; as such, every dog becomes a study of one across each veterinary context. Again, this reinforces the need for guardians (and veterinary staff) to accurately identify early signs of fear or distress in their dogs, and respond appropriately, as a preventative measure to trigger stacking. A greater awareness of how potential stressors can stack up will better prepare guardians and veterinary staff for the likelihood a dog will experience distress or how to help prevent it from occurring initially.

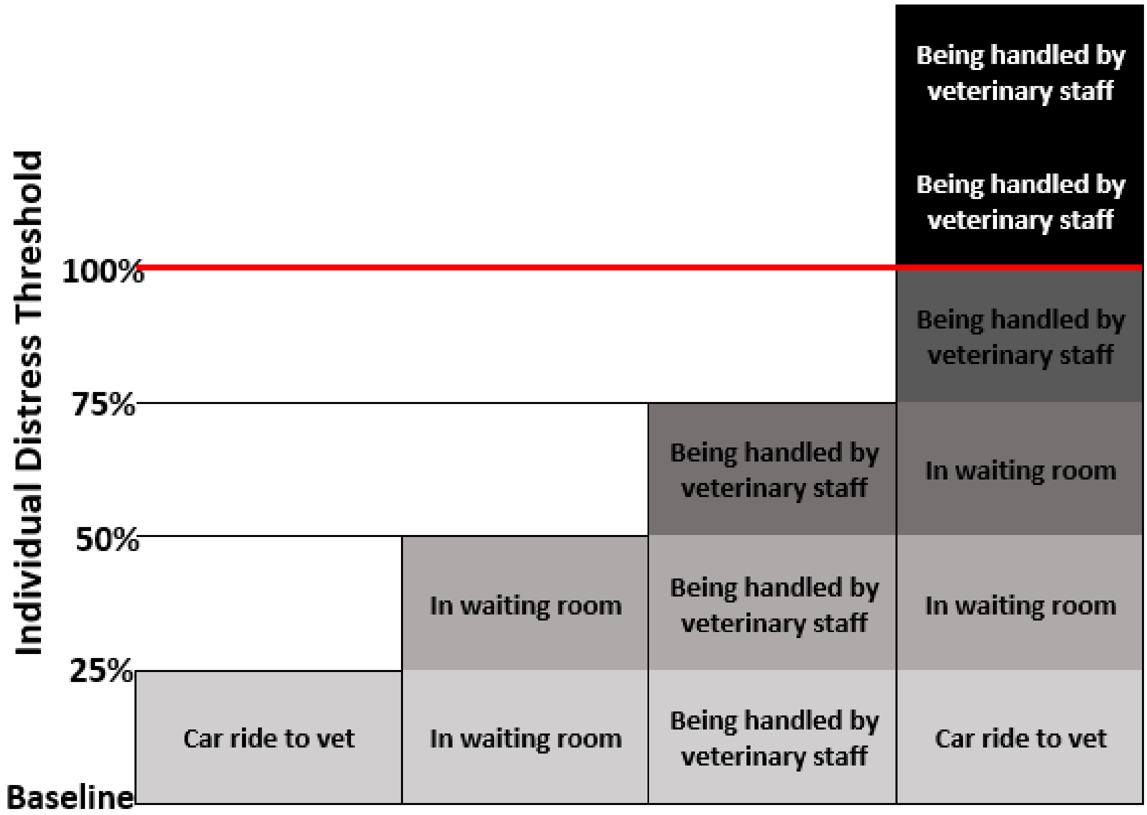

Figure 1: The 'trigger stacking effect'.

An example of how the cumulative effect of potential stressors involved in a veterinary visit may lead to distress, where the distress threshold differs for each dog. Each event has a level of stress associated with it when it occurs individually (e.g. car rides may be less stressful than being handled by veterinary staff), but stack up to result in distress when they occur within a short space of time. Adapted from 'The Trigger Stacking Effect' (YaletownDogTraining 2017)

1.5. Strategies to Reduce Stress

Despite established research on reducing stress in dogs in non-veterinary contexts like shelters, investigation into reducing stress in dogs during their veterinary care is limited. Many recommendations are sensible, but lack evidence to support their effectiveness beyond anecdotal observations. While the use of Dog Appeasing Pheromones (DAP) mitigates stress in the waiting room or while the dog is hospitalised (Kim et al. 2010), there is insufficient evidence to suggest DAP assists the reduction of fear or stress overall (Frank, Beauchamp & Palestrini 2010). Further, several reviews purport the benefits of pre-training for car rides and travel (in carriers or in the car) with treats and practice (Herron & Shreyer

2014; Lloyd 2017; Moffat 2008; Overall 2013), which may help reduce the trigger stacking effect. However, suggestions for pre-training recommended safety or management equipment like muzzles or other equipment that the dog will likely encounter throughout their veterinary visit (e.g. Elizabethan collars, hair or nail clippers, and isolated confinement in cages pre – and post-surgery) are lacking, although the conditioning of which is likely of equal benefit. Indeed, muzzle training can be a fun, interactive and engaging game to play with all companion dogs (Backman 2016). Interestingly, regarding the use of restraint in dogs during veterinary care procedures, Barletta and Raffe (2016) suggest that chemical restraint is more beneficial than manual restraint as it requires less staff on average, involves less contact time, and showed trends for improved cooperation and behaviour scores. As such, the benefits of chemical restraint likely outweigh the costs. Note, many recommendations for strategies to reduce stress are found in reviews (like Lloyd (2017), however evidence for their efficacy within a veterinary clinic is minimal. For instance, King et al. (2014) found anxious dogs had significantly lower average heart rate and a lower increase in heart rate for dogs wearing a Thundershirt® as per its instructions for use in comparison to those wearing a loose Thundershirt® or no wrap. However, the test was conducted in a training facility, measuring the effect of isolation on the dog where participants had already been diagnosed with Generalised Anxiety Disorder or Separation Anxiety. As such, the extent to which Thundershirt®s may be effective for the same or less severe fears or anxieties in a veterinary clinic where the guardian is present remains unknown.

Recommendations for strategies to reduce stress are generally based on the manipulation of the physical environment, social interaction, restraint or training and also by location within the clinic. The available recommendations from peer-reviewed literature to date have been summarised according to stakeholder responsibility (Tables 2, 3 & 4). In some cases, guardians are able to take responsibility for ameliorating distress experienced by their dogs in the veterinary context (Table 2). Guardians may be able to assist by being present during the consult, bringing their dog's mat or other comfort inducing items like toys for the visit, or embarking on some preventative training to reduce any distress experienced during the car ride to the veterinary clinic or within the waiting room. In addition to this, many of the recommended strategies to mitigate stress in the veterinary context are the responsibility of veterinary staff or veterinary clinic (Table 3). These include different ways the environment can be structured, manipulation of visual, audio or olfactory stimuli to alter perception of the potential stressors, staff interactions, education, changes to restraint protocols, or the use of training and desensitisation or counterconditioning protocols to counteract fearful experiences. Lastly, some recommendations to reduce stress during veterinary visits are the responsibility of both guardian and veterinary staff (Table 4), and include appropriate interactions, changes to restraint protocols, and training and counterconditioning or desensitisation approaches. Namely, a valuable opportunity to reduce stress comes in the form of guardian and veterinary staff education on the early signs of fear and stress in dogs, better enabling them to intervene earlier where necessary. However, while this sounds achievable in theory, requesting guardians invest more time or resources into their dogs may be challenging as surprisingly few companion dogs receive formal obedience training (Kobelt et al. 2003; Voith, Wright & Danneman 1992) or regularly get exercise outside their homes (Bauman et al. 2001; Howell, Mornement & Bennett 2016). The authors highlight that while the recommendations described in Tables 2, 3 and 4 are from peer-reviewed literature and appear common sense in nature, the evidence of the efficacy of many remains lacking.

Table 2: Guardian Intervention Checklist, with chronological order of location of veterinary experience, intervention type and description.

Intervention Type	Intervention
At Home:	
Training/DS/CC	• Bring your dog hungry so they might be more interested in treats[1,2]
	• Pre-training for carrier/ car ride, use of pheromones in carrier to assist[1,2,3,4]
At Home & Throughout Clinic:	
Training/DS/CC	• Weekly practice of as many aspects of 'routine' care as possible (e.g. pretend nail trims, ear, eye and teeth checks, tail lifts)[5] This could potentially be practiced through regular visits to the veterinary clinic, without a need to see the veterinarian, to ensure not all experiences at the veterinary clinic involve being examined

DS/CC – Desensitisation and Counter Conditioning learning processes that aim to reduce aggression or reactivity by changing the emotional state causing the behaviours.
References: [1] Lloyd (2017), [2] Moffat (2008), [3] Yin (2009), [4] Yin (2007), [5]Overall (2013), [6]Shepherd (2009)

Table 3: Veterinarian Intervention Checklist, with chronological order of location of veterinary experience, intervention type and description.

Intervention Type	Intervention
Throughout Clinic:	
Environmental Set Up	• Absorb adverse/ unpredictable clinic sounds by installing sound absorbing tiles, rubberised floors or wall panels, or solid doors or high ceilings[1,2,5,11] • Avoid excessive use of bleach, or dilute solution excessively. Allow time to air out rooms, or use other disinfectants that don't impact so negatively on a dog's olfactory neurons[1,5,6] • Use colours in soft yellow-violet range, avoid oranges, reds, darker colours and bright white, or turn down lights to avoid bright/ stark rooms (60W Recommended). Use lighter colours in darker areas to maximise their vision[1,5,6,11] • Wipe down surfaces after a stressed animal leaves to help remove any stress pheromones that will be perceived by the next patient[11] • Open a window (where appropriate) to allow fresh new scents to reach dogs that may assist in distracting them from other stressors, and also in airing out the rooms[1] • Provision of enriching and/or calming scents - lavender, chamomile essential oils (use with caution and in dog only areas) or pheromones, and sounds (relaxing classical music or audio books)[1,2,6,10,11,15] • Allow for wide door ways with panoramic view as much as possible to avoid surprise, and close confinement with other animals[5] • Maximise non-slip flooring (including in cages and runs) to provide the dog with as much traction, and therefore comfort, as possible[5] • Allow for one way flow of traffic through clinic, whereby clients enter through the front door and can leave via a side or rear door. Especially important for fearful or aggressive dogs[5,6] • Keep cats and dogs separate[14]
Interaction	• Remove white veterinary/ lab coat. Animals make associations with stimuli, including what is worn[6] • Be aware that dogs with recent veterinary visits (especially negative ones) are more likely to be stressed the current visit[7,8]

	• Ensure communication skills demonstrate compassion, highlight the human-animal bond, and be engaging and educational[9]
Restraint	• Be aware of the benefits and costs of restraint tools including head collars, air muzzles, Elizabethan collar, squeeze cage, nets and chemical restraint[2,6, 16] • If sedation is necessary, sedate early (before hyper-arousal) wherever possible. Avoid use of Acepromazine as a chemical restraint[1] • Be aware that the use of physical restraint for aggressive patients does not result in a less aggressive dog. Subsequent visits are likely to worsen unless a handling plan is created[5]
Clinic Notes	• Keep track of what worked well in a handling plan and what didn't[6] • Recorded notes on a short stress scale (e.g. Overall (2013)) or behavioural questionnaire (e.g. CBARQ - Hsu and Serpell (2003) for an accurate objective measure of behaviour change over time [1,5,14]
Interaction & Training/DS/CC	• For fearful and aggressive dogs, allow extra time to slow the whole process down[2]
Waiting Room:	
Environmental Set up	• Spread patients out as far as possible (temporally or physically), use visual barriers if possible, keep cats and dogs completely separate[1,2,5,14] • Reduce over-stimulation as a dog enters the clinic by ensuring the first thing they see is the reception desk[3] • Avoid placement of scales against a wall on in a corner, which may be more uncomfortable dogs to move toward. Clearly define the scale area with a different colour or non-slip surface and have it level with the floor[1,5,7] • Reception desk with low walls, curved (to allow for a greater visual block if two dogs are at reception at once), with multiple entry points can help ensure veterinary staff don't lean over to look at a dog[5] • Client bathrooms should be large enough to include the patient comfortably[5] • Provide tea, coffee and water for the client, and individual water bowls for the patient with a slightly longer wait, or a longer consult[5]
Staff Action	• Reception staff are primarily responsible for ensuring all patients and clients are checked in, comfortable and feeling safe only. Their role in identifying distressed dogs and making recommendations on how to best manage the dog

	during the wait is vital. Observations can also be reported to the veterinarian via real-time electronic notes. Answering phones should be done elsewhere to avoid disruption to patients and clients[5,14]
Exam Room:	
Environmental Set up	• Comfortable chairs to help guardian relax, non-slip surfaces, treats and toys available[1,6,14] • Exam rooms should be large enough to fit the average client family easily, plus dog, veterinarian, veterinary nurse and necessary equipment, with seats available for all and enough space for the dog to feel at ease[5,14] • If present, exam tables should be foldable, movable or available for alternate use as a desk to maximise floor space in the exam room[5] • All tools necessary for veterinary exam should be along one side of the room to avoid frequent and disturbing movement, or the need to step over the patient[5] • Rooms should have windows to allow the dog to see what they are walking in to/ out of, and blinds to provide privacy once inside[5]
Interaction	• Allow some time for the animal to habituate before beginning exam[1,2,7,14] • Examine patients where most comfortable (on laps, on floor (instead of table), in crates, partially hidden)[1,2,14] • Handle patients gently, and make vet visits fun with treats and toys that can be disinfected[2] • Consider use of butterfly catheters, where appropriate, for easier blood sampling, or using a vacutainer-type adapter to fill tubes directly[1,5,14] • Administer medication with the use of palatable treats to disguise the flavour. Use a pill administrator to avoid the medication's contact with the tongue[6] • Use the smallest gauge needle available for vaccination of patients. Change needles between drawing the vaccine and vaccination - sharpness matters[5]
Restraint	• Use the least restraint necessary to give the dog as much control as possible. Towels/blankets can be a less confrontational option. Be aware of the behavioural choices the dog has and ensure they always have room to avoid choosing aggression. Where greater restraint is necessary, use firm and balanced support[1,2,5,6,14] • Consider chemical restraint if urgent, or abandon and reschedule another day with different handling and training/DS/CC plan[2]

	• If a patient struggles only continue to restrain for 3 seconds, otherwise stop, release, wait for them to calm down and eat again, and then try in a different way. If this continues 2-3 times, stop and reassess - chemical restraint if it is urgent, if non-urgent, send the patient home and create a care /handling plan[2,6,14]
Staff Action	• Once the patient is in the exam room, all steps should be taken to avoid frequent entries and exits of the room[5]
Administration	• Bill payment, future booking and health care plans should be done in private. Stimuli that stress the client will stress the patient[5]
Training/DS/CC	• If a fearful or stressed dog is identified, set up a preventative behavioural health consult specifically to allow time to go through how that behaviour may be counter-conditioned/ trained at home in preparation for the next visit[4,5]
Cages/ Kennels/ Housing:	
Environmental Set up	• Keep cats and dogs separate[1,6,14] • Provide food dispensing enrichment toys like Kongs™, soft toys, scents or human interaction where possible to help alleviate boredom or stress[1,5] • Invest in noise reducing materials (laminate surfaces, ceramic tiles, acoustic ceiling tiles, glass cage doors to reduce audible stimuli[14] • Usual visual barriers on front of cages &/or allow ethologically appropriate places to hide inside[1,5,6,11,12,14] • Provide soft bedding in cages to encourage rest[6]
Clinic Notes	• Add 'What did you do today to take care of your patient's welfare?'[13]
Interaction	• Ensure staff understand how best to approach and interact with dogs when caged/ stressed. Have notes for animal on cage door that indicate that dog's comfort/ confidence around people[1,2]
Interaction & Environmental Set up	• Reduce sudden movements (or use one-way mirrors) and excessive noise (introduce a 'staff whisper zone', quiet clippers, non-slip mats on tables) in monitoring areas where dogs are recuperating[1,2]

DS/CC – Desensitisation and Counter Conditioning learning processes that aim to reduce aggression or reactivity by changing the emotional state causing the behaviours.

References: [1] Lloyd (2017), [2]Moffat (2008), [3] Yin (2009), [4] Yin (2007), [5]Overall (2013), [6] Herron and Shreyer (2014), [7] Hernander (2008), [8] Doring et al. (2009), [9] Knesl et al. (2016), [10] Engler and Bain (2017), [11] Herron (2015), [12]Hewson (2014), [13] Lloyd (2018) [14]Shepherd (2009), [15]Kim et al. (2010), [16] Barletta & Raffe, 2016

Table 4: Veterinarian and Guardian Intervention Checklist, with chronological order of location of veterinary experience, intervention type and description.

Intervention Type	Intervention
At Home & Throughout Clinic:	
Environmental Set up	• Veterinarians should encourage guardians (and guardians should feel welcome) to bring their dog's favoured bed and toy to relax on in the waiting room, weigh scale, consult room, consult table, or in cages/kennels/ housing during hospitalisation[2,5,11]
Interaction	• Greeting/Interaction Behaviours – stop a short distance away and invite dog to approach you. Avoid high pitched sounds and front on approaches. Greet dogs with their name and tasty treats or toys[1,2,4,5,6,11]
	• Recognise and respond appropriately to body language displayed[1,2,4,5,6,11]
Interaction & Training/DS/CC	• Use of a pressure wrap via TTouch® or Thundershirt® or ThunderCap® on the way to the clinic, or once in the clinic (desensitisation to cap may be required prior to use in clinic context)[1,5,6,13]
	• Don't wait for a problem to appear. Actively take steps to prevent fear/ distress at the veterinary clinic from a puppy[5]
	• Have an easily accessible stock of palatable treats including chicken or turkey baby food, peanut butter, squeeze cheese, Kong Paste, roast chicken, roast beef, TuckerTime, etc. Reward all behaviour you want to see more of, wherever possible (including being still, staying in a sit or relaxing on a mat). Be aware that the use of food may also help change the dog's emotional state through associative learning. Use treats or toys throughout all interactions and health checks where possible to maintain and build good relationships, positive experiences and prevent negative experience. Vaccinations are not emergencies, use them as an opportunity to work on building trust and comfort with patient. Use treats during and after potentially scary or painful procedures including injections, restraint, nail trims, rectal temperature/ palpation, otoscopic examinations, microchip placement, fine-needle aspirates, placement onto a cold table[2,4,5,6,7,11]
Carpark &/or Waiting Room:	
Environmental Set up	• Busy practices should encourage guardians with distressed, fearful or aggressive dogs to wait in the car (weather permitting), instead of a busy waiting room. Guardians can request this service if it's not offered.[5,11]

Restraint	• Guardian and Veterinarian to recognise dog might require sedation, Veterinarian to sedate[1,2,5]
Throughout Clinic:	
Interaction	• Have the guardian present and comforting the dog wherever possible, including outpatient workups (and viable dependent on that guardian's relationship with their dog and their physical ability to assist). Guardians can request this if it's not offered (and understand if the veterinary clinic is unable to cater for this)[2,5,6,7,8,11] • Be aware of best place to touch and interact with the dog, use soft, slow movements in the direction of the dog's hair. Move consistently and at an even, predictable pace, avoid sudden movements. Speak softly, clearly and calmly. Avoid handling around the head, shoulders, or paws. If necessary to touch those areas, be aware it may heighten a dog's discomfort. Avoid petting a dog that shows discomfort/ displacement behaviours [1,2,6,9,10]
Restraint	• Muzzle type (nylon vs basket), basket muzzles allow a dog to pant, drink and eat more easily, and can be easier to fit by smearing some peanut butter on the end. Guardians can purchase basket muzzles and practice training and desensitisation at home (training tips available via https://muzzleupproject.com/[12]) [1,2,6,]
Training/DS/CC	• Avoid Positive Punishment (e.g. harsh verbal reprimands, spray bottles, punitive-based training methods) for unwanted behaviour[1,5,6]

DS/CC – Desensitisation and Counter Conditioning learning processes that aim to reduce aggression or reactivity by changing the emotional state causing the behaviours.

References: [1] Lloyd (2017), [2] Moffat (2008), [3] Yin (2009), [4] Yin (2007), [5] Overall (2013), [6] Herron and Shreyer (2014), [7] Herron (2015), [8] Csoltova et al. (2017), [9] Kuhne, Hößler and Struwe (2012), [10] Kuhne, Hößler and Struwe (2014), [11] Shepherd (2009), [12] Backman (2016), [13] King (2014

Additionally, certifications are available to veterinary and dog training professionals, and guardians, that educate attendees on strategies to reduce stress and promote calm interactions at the veterinary clinic. A non-exhaustive summary of the programs available are presented in Table 5.

Table 5: Comparison of some examples of professional certifications and programs available to veterinary professionals, animal trainers and companion animal guardians regarding low stress handling techniques and cooperative care practices.

Course Title	Target Audience	Description	Completion Outcome	Reference
Fear Free[SM] Veterinary Certification	Veterinary Professionals ($279USD pp/ group discounts available)*	▪ Online course, 8 modules, with exam ▪ Professional membership to Fear Free[SM] organisation ▪ CE points recognised for other professional organisations ▪ Maintained yearly with annual fee and CE point ▪ Levels 2 and 3 also available	Fear Free [SM] Certified Practitioner	FearFree (2016)
Fear Free[SM] Practice Certification	Veterinary Practice (US and Canada only)	▪ Only available US and Canada ▪ Requires 25% or more of staff with patient/ client interaction to hold Fear Free[SM] certification ▪ Provides access to certification courses and resources to staff	Fear Free[SM] Certified Practice	FearFree (2016)
Fear Free[SM] Animal Trainer Certification	Animal Trainers ($199USD pp for non-members)*	▪ Online course, 6 modules ▪ Professional membership to Fear FreeSM ▪ CE points recognised for other professional organisations ▪ Maintained yearly with annual fee and CE points	Fear Free [SM] Certified Professional	FearFree (2016)
Fear Free[SM] Happy Homes	Companion animal guardians (Free**)	▪ Membership with access to veterinary visit resources and education for companion animal guardians	N/A	FearFree (2016)
Low Stress Handling® University	Veterinary Professionals, Animal Trainers and Companion animal guardians ($330 USD pp/ Group discounts available)*	▪ Online course, 10 modules, 1 exam per module ▪ CE points recognised for other professional organisations ▪ No renewal fees associated	Low Stress Handling® Certified - Silver	CattleDogPublishing (2018)

Better Veterinary Visits	Veterinary Professionals, Animal Trainers and Companion animal Guardians ($139 USD pp)	▪ Online Course, 5 Modules ▪ Provided in collaboration with the Fear Free^{SM} Program ▪ CE points recognised for other professional organisations ▪ No renewal fees associated	Not specified	KarenPryorAcademy (2017)
Ready… Set… For Groomer and Vet	Veterinary Professionals, Animal Trainers and Companion animal guardians (Free)	▪ Online program detailing valuable resources, articles and videos focused on teaching animals to participate in their own healthcare.	N/A	Monaco-Torelli (2018)

* Prices are based on information on the website, and are correct at time of publication
**With option for up to lifetime membership for $99USD

1.6. Potential to Practical: the difficulty with making industry changes

Human behaviour and choice are influenced by three different concepts as defined by the Theory of Planned Behaviour: attitudes about the behaviour (beliefs); how others perceive the behaviour (subjective norms); and, the extent to which the individual perceives they are able to control that behaviour (perceived behavioural control; Ajzen 1991). Generally, if the attitude toward the behaviour and the subjective norms are positive in nature, and the perceived behavioural control is high, the behaviour is more likely to be performed. Therefore, successful implementation of strategies to reduce stress during veterinary care rely heavily upon the stakeholder's (guardian or veterinarian) motivation for change, the attitude toward change from other staff, and in having the mental or physical capacity and workplace autonomy (including support from practice guardian or supervisors) for change. Todd (2018) suggests that barriers to the adoption of more humane training methods of companion dogs from the guardian's perspective, include an overall lack of knowledge or understanding of methods, and a lack of consensus between the 'experts' – trainers, veterinarians and animal behaviourists. As evidence of the efficacy of interventions designed to reduce distress during veterinary visits is lacking, it is likely their successful implementation of such strategies in the veterinary industry face similar hurdles.

At its core, implementing change is most effective in workplaces that foster attitudes that support change (Straatmann et al. 2018), and a similar approach is viable within the veterinary industry. Fostering a supportive and trusting workplace culture, actively involving all staff in the process, providing clear, concise and engaging communication surrounding the change and developing positive attitudes toward change are highlighted as significant aspects of successful workplace change strategies (Oreg, Vakola & Armenakis 2011; Parchman et al. 2017; Souza et al. 2017; Straatmann et al. 2018). Indeed, Straatmann et al. (2018) suggest at least two of the factors of the Theory of Planned Behaviour (either beliefs, perceived behavioural control or subjective norms) should be addressed for successful adoption of workplace change.

From this perspective, implementing positive, stress reducing change in veterinary clinics is difficult, considering the number of stakeholders and decision makers involved: veterinary staff, practice managers, business owners, professional organisations or governing bodies, and the guardian. Many of the recommendations for change to improve welfare (like non-slip exam tables, use of pheromones, or restructuring waiting rooms) are out of the control of the veterinary staff working with the dog and the guardian, and depend instead on the practice owner or financial viability. Further, where valuable recommendations like increasing guardian or veterinary professional education on the early signs of stress and fear in dogs appear achievable, they rely on those individuals making the time to invest in learning more in a day and age where time and resources are limited (perceived behavioural control). However, incremental changes in areas that can be readily changed, such as bringing a mat or toy to help the dog relax, or allowing the dog time to habituate in the consult room, may result in positive benefits, such as reduced distress or positive owner feedback that can be used to drive further change.

1.7. Conclusion

As we have shown here, stress experienced by dogs visiting veterinary clinics is a complex issue. There are a number of factors which may lead to the dog's experience, and each dog will experience veterinary visits differently. What we do know, is that a high proportion of dogs show signs of stress or fear at least some of the time. Unfortunately, evidence indicating that one aspect of veterinary care is more useful in reducing stress over another is limited. As such, it is difficult to ascertain when, where and how best to implement strategies to reduce stress for maximum effect. Further, investigation into stress interventions in the veterinary clinic will be most useful where it incorporates the dynamic relationship between dog, guardian and veterinary staff. Such interventions should also be carefully considered in terms of how they will best meet criteria for successful implementation as defined by the Theory of Planned Behaviour; the guardian and veterinary staff's positive attitudes, subjective norms and perceived behavioural control toward adopting such strategies. Research on interventions designed to reduce distress during veterinary visits should be prioritised based on the likelihood of their effective implementation in the workplace. Numerous opportunities for the continual improvement of animal welfare within the veterinary context exist, however further investigation is essential in determining which strategies will not only be the most effective and efficient in reducing distress, but also which are most likely to be adopted successfully across the veterinary industry.

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Chapter 2

Investigating risk factors that predict a dog's fear during veterinary consultations

Introduction

This chapter was the first to investigate the prevalence and risk factors that predict fear of the veterinary clinic from a large global sample of 26, 555 guardians using their responses to the Canine Behavioral and Research Questionnaire (C-BARQ). Chapter 1 highlights a dog's fear response in the veterinary context is based on their *perception* of risk, rather than the actual risk. Determining the cause of fear of the veterinary clinic is integral to implementing strategies to reduce that fear. A dog's genetic predisposition may be a contributing factor to the way they perceive or respond to a veterinary experience. In an attempt to gain a greater understanding of factors that may be influencing a dog's veterinary experience, this Chapter investigates the extent to which dog demographics (e.g. sex, size, breed group) predicts how a dog responds to veterinary examinations as reported by their guardians.

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Abstract

Attending the veterinary clinic is an integral part of the physical welfare of every companion dog. However, some dogs experience their veterinary visits negatively, which poses a risk of injury to the veterinary staff, their guardian (owner) and themselves. It may also influence the regularity of non-urgent veterinary appointments. To date there have been conflicting reports relating to the proportion of dogs that show fear during their veterinary visits. In this study, we explored the risk factors associated with fear during veterinary examination and in novel situations (including first time at the veterinary clinic) from 26,555 responses in the Canine Behavioral Assessment and Research Questionnaire database. According to their guardians, 41% of companion dogs displayed mild to moderate fearful behaviour when examined by a veterinarian, and 14% exhibited severe or extreme fear. A similar trend was observed with dogs responding fearfully when in unfamiliar situations, including the dog's first time at the veterinary clinic. Chi-squared tests showed every bivariate relationship between fear and the environmental and demographic factors measured was significant ($p < 0.05$). The most important predictors of fear in a veterinary examination were, in order: the dog's breed group (27.1%), their history of roles or activities (16.7%), where they were sourced (15.2%), their weight (12%), the age of other dogs in the household (9.5%) and dog owner experience (6.3%). However, combined these risk factors only explain a total of 7% of variance of fear observed during veterinary examination. This suggests that fear exhibited during veterinary visits is common in dogs, but that the environment or human-animal interactions are likely to contribute more to prevalence and severity of this problem than the demographic factors measured here. We conclude by highlighting opportunities for future research aimed at facilitating less stressful veterinary visits for dogs and their guardians.

2.1. Introduction

Visits to veterinary clinics are integral to maintaining and improving the health and welfare of domestic dogs. However, the veterinary experience can also be stressful for them. It is currently estimated that between 10% and 78.5% of dogs become stressed or fearful in the veterinary clinic [1-14]. For example, Doring et al. [4] identified 13% of dogs refused to enter the veterinary clinic, Stanford [1] reported that 70% of dogs were unwilling to enter, and Mariti et al. [9] observed 29% of dogs displaying 'extreme' stress in the waiting room. Mariti et al. [11] found guardians (pet owners) reported only 36.4% of 906 dogs tested were calm in the waiting room, while the majority displayed signs of fear, excitement (37.6%) and/or aggression (3.4%). Such disparity in prevalence is likely a reflection of the methodology employed. For example: variation in the behavioural and physiological measures used to assess stress or fear; the person taking the measurement (e.g. investigator, guardian, veterinary nurse, veterinarian); the locations within the veterinary clinic where stress is measured (e.g. waiting room, examination room or kennels and cages); and the context (e.g. owner present/ absent, mock/real examination). This makes an accurate estimate of the prevalence of stress or fear in dogs visiting veterinary clinics difficult to ascertain.

Negative veterinary experiences can have long-term impacts for the dog, guardian and veterinary staff. A North American study found that the very idea of taking a dog to the veterinary clinic can cause guardians to become stressed (26%). In fact, many guardians (38%) believe that their dog 'hates' going to the veterinarian [7]. As such, guardians want to see their veterinarian interact compassionately with their dog [15], especially when certain methods of handling and restraint can be stressful for animals [16-19]. These attitudes and experiences affect guardian decisions about which veterinarian they see and how often they attend [7]. Further, the behavioural or physiological signs of fear and distress can mirror those of pain, illness and some neurological conditions [20], making accurate diagnoses difficult. Not only can stressed or fearful dogs at the veterinary clinic injure themselves, but they also pose a risk of injury to the veterinary staff and their guardians [20]. Addressing fear at the veterinary clinic and promoting pet-friendly practice is integral to the continual improvement of companion animal welfare.

With the exception of the dog's sex and age [4], estimated adult weight [3], and the benefit of supportive guardian presence [12], our understanding of dog and guardian characteristics that may exacerbate or ameliorate a dog's fear or stress response at the veterinary clinic is limited. In order to address this shortfall, we explored the proportion of dogs that show fearful behaviours during veterinary visits according to a large sample of guardians. To do this, we analysed two fear-related, veterinary specific questions and their corresponding behavioural subscales from the Canine Behavioral Assessment and Research Questionnaire (C-BARQ). The C-BARQ is a validated research questionnaire available online to dog guardians [21]. It has been used extensively to investigate factors that influence dog behaviour, personality and temperament in general [22-27], as well as to explore how domestication has influenced behaviour more specifically [28]. The C-BARQ has also been used to measure the behavioural effects of neutering in dogs [29,30], and to investigate the factors associated with aggression [31-33], trainability [34], boldness traits [35], how training can impact dog intelligence [36], how dog behaviour or temperament can influence their health and lifespan [37], and the relationship between dogs and their owners [38]. As such, this extensive dataset of dogs provides an opportunity to build on our understanding of how dogs experience their veterinary care.

2.2. Method

2.2.1. C-BARQ

C-BARQ contains 100 behavioural items (questions) grouped into 14 subscales (factors) extracted by factor analysis [21]. Guardians respond on a 5-point Likert scale for how serious that behaviour is for their dog or how often it is performed, with '0' being 'none/ never' and '4' being 'extreme/ always'. C-BARQ provides guardians with clear examples of what mild to moderate fear may look like in their dog: "avoiding eye contact, avoidance of the feared object; crouching or cringing with tail lowered or tucked between the legs; whimpering or whining, freezing and shaking or trembling". Similarly, extreme fear is described as: "exaggerated cowering, and/or vigorous attempts to escape, retreat or hide from the feared object, person or situation". In this study, C-BARQ responses to two items (questions) related to fear in a veterinary context were analysed to explore the relationship between dog experience at the veterinary clinic, and dog and guardian factors (see Table 1 and 2 for details). The items (Questions 43 and 47) asked guardians to report on the extent to which their dog exhibits fearful behaviour during a veterinary examination (Q43; 'fear of veterinary examination'), and in unfamiliar situations, including examples of first car trip, first time in elevator, first visit to veterinarian, etc. (Q47; 'fear of unfamiliar'). The two items, fear of veterinary examination and fear of unfamiliar, loaded onto two different behavioural subscales, touch sensitivity and non-social fear, respectively. Touch sensitivity consisted of 4 items (Questions 43, 49, 50 and 51) and refers to dogs that show fearful or wary responses to potentially painful or uncomfortable procedures, including bathing, grooming, nail-clipping and veterinary examinations [21]. Non-social fear contained 6 items (Questions 38, 41, 42, 44, 47 and 48), and refers to dogs that are fearful or wary of sudden or loud noises (e.g. thunder), traffic, and unfamiliar objects and situations [21]. In this study, the predictive value of factors on fear responses in the veterinary context is explored via the two veterinary specific items

(Q43 and Q47) in conjunction with the two validated behavioural subscales (touch sensitivity and non-social fear).

2.2.2. Dog sample

Retrospective data was collected from guardians completing C-BARQ online (https://vetapps.vet.upenn.edu/cbarq/) between 2005 and 2016. Responses that did not include answers to the vital items – Question 43 (fear of veterinary examination) and Question 47 (fear of unfamiliar situations) – were excluded. Breeds were then categorised into breed groups via the Australian National Kennel Council (ANKC) breed list. In the event that a breed was unrecognised by the ANKC, it was categorised in accordance with the American Kennel Club (AKC) (e.g. American Eskimo dog, rat terrier, great Pyrenees, chinook, Spanish water dog). Some breeds were identified in ANKC by a different name (e.g. Belgian sheepdog as groenendael; English bulldog as British bulldog). Breeds not recognised by the ANKC, AKC or the Fédération Cynologique Internationale (FCI) breed lists (English shepherd and American pit bull terrier), were removed. Dogs listed as crossbreeds or of unknown breed were included as 'mixed breed'. Only dog breeds with a minimum of 50 responses were included. Dog age, neuter age, and age of acquisition were converted into years, and dog weight converted to metric (lbs to kg). C-BARQ is available for guardians with dogs six months and over, and as such, 'puppies (<6 months)' in this study refer only to dogs that were six months of age at the time of evaluation (N = 583). This research was considered 'negligible risk' as it involved the use of an existing collection of non-identifiable data and there was no foreseeable risk of harm or discomfort. As such, it was granted a formal waiver of ethics approval from The University of Adelaide Human Research Ethics Committee review.

2.2.3. Statistical Analysis

Cross-tabulations were performed using the R statistical programming environment [39] between all independent variables and the outcome measures, fear of veterinary examination and fear of unfamiliar. Chi-square tests revealed that every bivariate relationship between fear response and environmental and demographic variables were significant, due to the large sample size. Accordingly, our analyses focused on determining the magnitude of effect sizes, and assessing the relative importance of each variable in predicting fear of veterinary examination and fear of unfamiliar, in both a univariate and multivariate context. In the first step, we assessed relative importance using two metrics within a framework called *dominance analysis* [40, 41]. The first metric is calculated by entering each variable in isolation (e.g. simple regression), and expressing each model R^2 relatively: e.g. as a percentage of the sum of R^2 explained by all models. The second metric, *lmg* [42], considers the R^2 over all possible combinations of predictors: e.g. given predictors X1, X2, X3, models y ~ X1, y ~ X2, y ~ X3, y ~ X1 + X2, y ~ X2 + X3, y ~ X1 + X3, y ~ X1 + X2+ X3 are considered. Thus, a single predictor's relative contribution is assessed in terms of the drop in R^2 when it is removed, in all possible multivariate contexts. In the second step, two multiple regression models were fitted for fear of veterinary examination, fear of unfamiliar, touch sensitivity and non-social fear. The first model included all predictors ('all-in' regression model). The second model included only those predictors that contributed more than 5% of the explained variance according to the *lmg* importance metric ('parsimonious' regression model). Though 5% is an arbitrary threshold for inclusion, in contrast to stepwise methods the *lmg* criteria is a robust variable selection method, because the entire space of possible regression models is evaluated [43]. A Spearman rank-order correlation between fear of veterinary examination and fear of unfamiliar, and the two subscales touch sensitivity and non-social fear was conducted to ascertain the overlap between individual dogs.

2.3. Results

The sample of 26,555 valid responses was evenly distributed by dog sex (51.79% male; Table 1), and the mean dog weight was 22.78kg (±14.57kg; median 21.60kg). The mean dog age was 4.52 years (±3.5 years; median 4.00 years), mean neuter age was 0.84 years (±1.5 years; median 0.48 years) and mean age acquired was 0.77 years (±1.49 years; median 0.21 years). The majority of dogs were healthy (84.63%), neutered (75.67%), and purchased as companions (70.97%), with no specific sporting or working role. The most common reasons for neutering were birth control (25.85%), and required by breeder (23.72%). Dogs were most commonly acquired from a breeder (41.38%) and shelter or rescue (31.03%), while the least common source for dogs was a pet store (3.47%), followed by those bred by their guardians (4.08%). The majority of guardians were experienced dog owners, having had dogs previously as adults (81.82%) and/or as children (80.11%). Just over half of dogs (62%) were from multi-dog households. Mixed breeds or dogs of unknown breed were the most commonly reported (27.75%), followed by working breeds (16.41%) and gundogs (15.77%).

Of the 26,555 dogs, 41.02% exhibited mild to moderate fearful behaviour when examined by a veterinarian, and a total of 14.23% of all guardians reported that their dog showed severe or extreme fear during veterinary examination. That is, over half (55.25%) of all dogs showed fear in some capacity in a veterinary context. Similarly, 46.68% of dogs showed mild-moderate signs of fear in new situations, including potentially the first visit to the veterinary clinic, while 11.02% of all dogs displayed severe or extreme fear in unfamiliar situations. In contrast, just over a third of dogs displayed at least some form of fear (mild-extreme) for the corresponding subscales of touch sensitivity and non-social fear (35.01% and 37.00% respectively). The correlation between fear of veterinary examination and fear of unfamiliar was 0.45 ($p < 0.001$), and between the two subscales touch sensitivity and non-social fear was 0.44 ($p <0.001$). The mean score of fear for both items (fear of veterinary examination and fear of unfamiliar) and both subscales (touch sensitivity and non-social fear) for each of the independent variables are displayed in Table 1.

Table 1: Summary of demographic and environmental covariates and cross-tabulation with mean and standard deviations (SD) of C-BARQ fear variables (with '0' being 'no fear', and '4' being 'extreme fear').

	Label	N	%	Fear of veterinary examination	Fear of unfamiliar	Touch sensitivity	Non-social fear
				Mean (SD)			
Sex	Male	13754	51.79	1.04 (0.010)	1.01 (0.010)	0.76 (0.007)	0.83 (0.007)
	Female	12801	48.21	1.09 (0.011)	1.01 (0.010)	0.76 (0.007)	0.86 (0.007)
Age	Puppy (<0.5yr)	583	2.20	0.81 (0.048)	1.02 (0.046)	0.67 (0.031)	0.80 (0.031)
	Adolescent (0.5-3yr)	12033	45.31	1.01 (0.011)	1.05 (0.010)	0.73 (0.007)	0.83 (0.007)
	Adult (>3yr)	13939	52.49	1.12 (0.010)	0.97 (0.009)	0.79 (0.007)	0.86 (0.007)
Breed group	Gundogs	4188	15.77	0.79 (0.017)	0.80 (0.015)	0.58 (0.011)	0.68 (0.011)
	Hounds	1481	5.58	1.16 (0.032)	1.05 (0.029)	0.82 (0.021)	0.86 (0.021)
	Mixed Breed/Unknown	7370	27.75	1.33 (0.015)	1.27 (0.014)	0.95 (0.010)	1.04 (0.010)
	Non-Sporting	2138	8.05	1.06 (0.026)	0.99 (0.024)	0.74 (0.017)	0.83 (0.016)
	Terrier	1475	5.55	0.97 (0.030)	0.87 (0.028)	0.74 (0.020)	0.88 (0.020)
	Toys	1986	7.48	1.36 (0.029)	1.10 (0.026)	0.97 (0.020)	0.91 (0.018)
	Utility	3560	13.41	0.74 (0.018)	0.79 (0.017)	0.57 (0.012)	0.66 (0.012)
	Working	4357	16.41	1.00 (0.018)	0.95 (0.016)	0.66 (0.011)	0.77 (0.011)
Weight	Smaller (<22kg)	13331	50.20	1.21 (0.011)	1.09 (0.010)	0.87 (0.007)	0.93 (0.007)
	Larger (>22kg)	13224	49.80	0.91 (0.010)	0.93 (0.009)	0.65 (0.006)	0.75 (0.006)
Neuter status	No	6460	24.33	0.88 (0.014)	0.88 (0.013)	0.61 (0.009)	0.68 (0.009)
	Yes	20095	75.67	1.12 (0.009)	1.05 (0.008)	0.81 (0.006)	0.90 (0.006)
Neutered age	<6 months	16655	62.72	1.05 (0.009)	1.00 (0.009)	0.75 (0.006)	0.83 (0.006)
	6-12 months	4849	18.26	1.12 (0.018)	1.05 (0.016)	0.80 (0.011)	0.88 (0.011)

	12-18 months	1374	5.17	1.05 (0.033)	1.01 (0.030)	0.75 (0.021)	0.85 (0.021)
	>18 months	3677	13.85	1.07 (0.020)	0.99 (0.019)	0.75 (0.013)	0.85 (0.014)
Reason for neutering	Birth control	6864	25.85	1.10 (0.015)	1.04 (0.014)	0.79 (0.010)	0.89 (0.009)
	Correct behaviour problems	695	2.62	1.25 (0.051)	1.07 (0.045)	0.87 (0.033)	0.87 (0.029)
	Correct health problems	367	1.38	1.02 (0.063)	0.85 (0.058)	0.70 (0.039)	0.72 (0.040)
	NA	6809	25.64	0.89 (0.014)	0.89 (0.013)	0.62 (0.009)	0.69 (0.009)
	Prevent behaviour problems	796	3.00	1.16 (0.044)	1.04 (0.038)	0.86 (0.029)	0.87 (0.026)
	Prevent health problems	1646	6.20	1.06 (0.030)	0.90 (0.026)	0.74 (0.019)	0.79 (0.017)
	Recommended by veterinarian	1320	4.97	1.22 (0.035)	1.13 (0.032)	0.88 (0.023)	0.95 (0.022)
	Required by breeder	6298	23.72	1.16 (0.016)	1.14 (0.015)	0.84 (0.011)	0.96 (0.010)
	Unknown	1439	5.42	0.98 (0.031)	0.88 (0.028)	0.68 (0.020)	0.80 (0.021)
Source	Bred by owner	1083	4.08	0.73 (0.032)	0.76 (0.030)	0.47 (0.020)	0.56 (0.020)
	Breeder	10988	41.38	0.88 (0.011)	0.83 (0.010)	0.63 (0.007)	0.70 (0.007)
	Friend or relative	2451	9.23	1.30 (0.026)	1.16 (0.023)	0.91 (0.017)	0.94 (0.016)
	Other	1420	5.35	1.05 (0.032)	1.00 (0.031)	0.76 (0.021)	0.85 (0.021)
	Pet store	922	3.47	1.37 (0.042)	1.17 (0.038)	0.93 (0.028)	1.05 (0.026)
	Shelter or rescue	8241	31.03	1.22 (0.014)	1.18 (0.013)	0.89 (0.009)	1.00 (0.009)
	Stray	1450	5.46	1.26 (0.034)	1.23 (0.031)	0.92 (0.023)	1.00 (0.021)
Age when acquired	Puppy (<0.5yr)	18842	70.95	1.03 (0.009)	0.97 (0.008)	0.74 (0.006)	0.81 (0.006)
	Adolescent (0.5-3yr)	6320	23.80	1.15 (0.016)	1.12 (0.015)	0.82 (0.010)	0.93 (0.010)
	Adult (>3yr)	1393	5.25	1.12 (0.033)	1.06 (0.032)	0.80 (0.023)	0.91 (0.023)
Health problems	No	22474	84.63	1.05 (0.008)	1.01 (0.007)	0.75 (0.005)	0.84 (0.005)
	Yes	4081	15.37	1.14 (0.020)	1.01 (0.018)	0.80 (0.013)	0.87 (0.012)
Role	Breeding & showing	2247	8.46	0.65 (0.021)	0.74 (0.021)	0.49 (0.014)	0.59 (0.014)

	Field trials / hunting	454	1.71	0.78 (0.050)	0.72 (0.043)	0.55 (0.031)	0.58 (0.030)
	None	18845	70.97	1.18 (0.009)	1.12 (0.008)	0.85 (0.006)	0.94 (0.006)
	Other sports	3545	13.35	0.92 (0.019)	0.76 (0.016)	0.61 (0.011)	0.65 (0.011)
	Working	1463	5.51	0.64 (0.026)	0.65 (0.024)	0.49 (0.016)	0.55 (0.017)
First dog owned	No	21728	81.82	1.01 (0.008)	0.99 (0.008)	0.72 (0.005)	0.82 (0.005)
	Yes	4827	18.18	1.30 (0.019)	1.09 (0.016)	0.94 (0.012)	0.95 (0.011)
Owned dog as child	No	5281	19.89	1.12 (0.017)	1.02 (0.015)	0.79 (0.011)	0.87 (0.011)
	Yes	21274	80.11	1.05 (0.008)	1.01 (0.008)	0.75 (0.005)	0.84 (0.005)
Age of other household dogs	NA	9932	37.40	1.22 (0.013)	1.10 (0.011)	0.87 (0.008)	0.95 (0.008)
	Older	5929	22.33	0.98 (0.015)	1.05 (0.015)	0.69 (0.010)	0.82 (0.010)
	Older and same	479	1.80	1.03 (0.056)	1.07 (0.053)	0.67 (0.037)	0.80 (0.040)
	Older and younger	3001	11.30	0.86 (0.021)	0.86 (0.020)	0.61 (0.014)	0.68 (0.014)
	Older, younger and same	748	2.82	0.83 (0.041)	0.85 (0.040)	0.57 (0.028)	0.63 (0.028)
	Same	1216	4.58	1.11 (0.036)	1.05 (0.033)	0.78 (0.023)	0.89 (0.023)
	Younger	4887	18.40	1.00 (0.017)	0.90 (0.015)	0.74 (0.011)	0.78 (0.011)
	Younger and same	363	1.37	0.99 (0.060)	0.93 (0.057)	0.73 (0.043)	0.76 (0.040)

2.3.1. Multivariate regression of fear response

Linear regression models were used to explore the predictive importance of dog and guardian factors in determining fear of veterinary examination and fear of unfamiliar. Table 2 highlights the relationships between the different environmental and demographic factors predicting fearful behaviour, analysed through parsimonious regression models for fear of veterinary examination, fear of new situations, touch sensitivity and non-social fear. Considering 'all in' analyses yielded only a slight increase in explained variance of fear responses in comparison to parsimonious models, we focus on the latter. The parsimonious models were significant for all dependent variables, explaining 7.06% of variance in fear of veterinary examination ($F= 56.01$, $df = 34, 25058$, $p< 0.01$), 8.58% of variance in touch sensitivity subscale ($F= 69.19$, $df = 34, 25058$ $p < 0.01$), 5.45% of variance of fear of unfamiliar ($F = 43.73$, $df = 33, 25059$, $p < 0.01$), and 8.24% of variance of non-social fear subscale ($F = 68.21$, $df = 33, 25059$, $p < 0.01$). This effect size refers to the proportion of the variation in fearful behaviour that can be attributed to the factors discussed in the following section. For example, approximately 7.06% of the variation of fear observed during veterinary examinations can be attributed to these factors. Likewise, these factors account for 5.45% of the variation in fearful behaviour observed in unfamiliar situations. The constant (intercept) represents the grand mean score of fear response for all dependent variables (fear of veterinary examination, fear of unfamiliar, touch sensitivity and non-social fear) for all referents (e.g. gundogs or hounds within breed group). The referent score (unstandardised beta coefficient; *B*) follows the same scale used when guardians reported on each item in C-BARQ, where a score of '0' equates to 'no fear', and '4' represents 'extreme fear'. A dog's predicted fear response score is calculated with the equation: $B*1 + \text{Constant}$. As such, coefficients reflect adjustments to the conditional mean, given each of the predictors.

Table 2: Summary of multivariate regression models indicating the predicted severity of fear response (unstandardised Beta coefficients (*B*) and standard error (SE)) by factor during veterinary examination, unfamiliar situations, touch sensitivity and non-social fear.

Factors	Fear of veterinary examination	Fear of unfamiliar	Touch sensitivity	Non-social fear
Breed group				
Gundogs	-	-	-	-
Hounds	0.2980* (0.0372)	0.2002* (0.0340)	0.1839* (0.0237)	0.1220* (0.0233)
Mixed Breed/Unknown	0.3217* (0.0261)	0.2747* (0.0238)	0.1927* (0.0166)	0.1697* (0.0164)
Non-Sporting	0.1479* (0.0331)	0.1095* (0.0302)	0.0726* (0.0211)	0.0557* (0.0207)
Terrier	0.0702 (0.0376)	-0.0177 (0.0343)	0.0591 (0.0240)	0.0991* (0.0236)
Toys	0.3823* (0.0355)	0.1508* (0.0325)	0.2309* (0.0226)	0.0871* (0.0223)
Utility	-0.0061 (0.0278)	0.0005 (0.0254)	0.0147 (0.0177)	-0.0036 (0.0174)
Working	0.2244* (0.0268)	0.1747* (0.0245)	0.0901* (0.0171)	0.1026* (0.0168)
Weight				
Smaller (<22kg)	-	-	-	-
Larger (> 22kg)	-0.1712* (0.0166)	-0.0927* (0.0151)	-0.1245* (0.0104)	-0.1443* (0.0106)
Reason for Neutering				
Birth Control	-	-	-	-
Correct behaviour problems	0.2174* (0.0477)	0.1231* (0.0436)	0.1202* (0.0304)	0.0449 (0.0300)
Correct health problems	0.0647 (0.0642)	-0.0315 (0.0587)	0.0053 (0.0409)	-0.0327 (0.0403)
NA	-0.0593* (0.0219)	-0.0309 (0.0200)	-0.0644* (0.0139)	-0.0854* (0.0137)
Prevent behaviour problems	0.0544 (0.0448)	0.0380 (0.0409)	0.0681 (0.0285)	-0.0135 (0.0281)
Prevent health problems	0.0089 (0.0328)	-0.0765 (0.0300)	-0.0220 (0.0209)	-0.0544* (0.0206)
Recommended by veterinarian	0.0663 (0.0363)	0.0829 (0.0332)	0.0565 (0.0231)	0.0336 (0.0228)
Required by breeder	-0.0405 (0.0236)	0.0067 (0.0215)	-0.0239 (0.0150)	-0.0152 (0.0148)
Unknown	-0.0949* (0.0350)	-0.1256* (0.0319)	-0.0894* (0.0223)	-0.0778* (0.0219)
Source				
Bred by owner	-	-	-	-
Breeder	-0.0170 (0.0399)	-0.0043 (0.0365)	0.0361 (0.0254)	0.0274 (0.0250)
Friend or relative	0.2377* (0.0465)	0.1802* (0.0425)	0.2127* (0.0297)	0.1634* (0.0292)
Other	0.0725 (0.0508)	0.0858 (0.0464)	0.1150* (0.0324)	0.1262* (0.0319)
Pet store	0.2146* (0.0567)	0.1687* (0.0517)	0.1598* (0.0361)	0.2220* (0.0355)
Shelter or rescue	0.1633* (0.0443)	0.1635* (0.0405)	0.1780* (0.0282)	0.1891* (0.0278)
Stray	0.1710* (0.0519)	0.1719* (0.0474)	0.1955* (0.0331)	0.1762* (0.0326)

Role				
Breeding & showing	-	-	-	-
Field trials /hunting	0.1254 (0.0623)	-0.0151 (0.0569)	0.0503 (0.0397)	-0.0347 (0.0391)
None	0.2551* (0.0300)	0.1867* (0.0274)	0.1489* (0.0191)	0.1370* (0.0188)
Other Sports	0.1324* (0.0337)	-0.0693 (0.0308)	0.0131 (0.0215)	-0.0588* (0.0211)
Working	-0.0844 (0.0415)	-0.1612* (0.0379)	-0.0563 (0.0265)	-0.1265* (0.0261)
First dog owned				
No	-		-	
Yes	0.1622* (0.0203)		0.1166* (0.0130)	
Age of other household dogs				
Single dog	-	-	-	-
Older	-0.1328* (0.0209)	0.0190 (0.0185)	-0.0925* (0.0133)	-0.0660* (0.0127)
Older and same	-0.0813 (0.0571)	0.0266 (0.0519)	-0.1157* (0.0364)	-0.0855 (0.0356)
Older and younger	-0.1858* (0.0265)	-0.0971* (0.0238)	-0.1172* (0.0169)	-0.1462* (0.0163)
Older, younger and same	-0.2221* (0.0476)	-0.1202* (0.0432)	-0.1456* (0.0303)	-0.1858* (0.0297)
Same	-0.1273* (0.0369)	-0.0589 (0.0336)	-0.0919* (0.0236)	-0.0747* (0.0231)
Younger	-0.1425* (0.0214)	-0.1220* (0.0194)	-0.0706* (0.0136)	-0.1137* (0.0134)
Younger and same	-0.1945* (0.0641)	-0.1537* (0.0585)	-0.1028 (0.0409)	-0.1593* (0.0401)
Constant (Intercept)	0.7507* (0.0531)	0.7526* (0.0483)	0.5643* (0.0338)	0.7213* (0.0331)
N	25,093	25,093	25,093	25,093
R2 (%)	7.06	5.45	8.58	8.24
Adjusted R2	6.94	5.32	8.46	8.12
Residual Std. Error	1.1717 (df = 25058)	1.0707 (df = 25059)	0.7470 (df = 25058)	0.7354 (df = 25059)
F Statistic	56.0120* (df = 34, 25058)	43.7294* (df = 33, 25059)	69.1927* (df = 34, 25058)	68.2073* (df = 33, 25059)

Notes: *p<0.01; standard errors are given in brackets after unstandardised Beta coefficients. All factors dummy coded (0,1); unstandardised beta coefficients (*B)* reflect mean differences from the reference category. All dependent variables scaled from 0 (no fear) to 4 (extreme fear)

2.3.2. Relative importance of factors in explaining variation of fear

The relative importance of each of the factors in predicting fear of veterinary examination, fear of unfamiliar, touch sensitivity and non-social fear are shown in Table 3. While both bivariate ('first') and multivariate ('*lmg*') analyses are displayed, only the multivariate results are discussed here as both models demonstrate a similar pattern of effects. Fourteen variables explained more than 5% of the variation in fearful behaviour observed, and are listed in descending order of importance. Only those factors that can be assigned to over 5% of the effect size observed are discussed. A dog's breed group was the strongest predictor of fear of veterinary examination (27.14%), fear of unfamiliar (26.98%) and touch sensitivity (23.15%). Non-social fear was the only scale in which both role of the dog (24.35%) and dog source (20.02%) explained more of the variance of fear than breed group (18.70%). Role of the dog, dog source, weight and age of other dogs in the household were important factors across all scales. The reason for neutering contributed to the variance of fear observed in all scales, except fear of veterinary examination, while whether the guardian had owned dogs before was only important in fear of veterinary examination and touch sensitivity. Overall, these factors were significant in predicting fear responses in a veterinary context and are important in identifying how dogs experience their veterinary care.

Table 3: Relative variable importance (%) in predicting fearful behaviour from C-BARQ items fear of veterinary examination and fear of unfamiliar and subscales touch sensitivity and non-social fear in a bivariate ('first') and multivariate ('*lmg*') context. *lmg* scores that indicate the variable captures more than 5% of explained variance in fearfulness are discussed in text.

	Fear of veterinary examination		**Fear of unfamiliar**		**Touch sensitivity**		**Non-social fear**	
Predictor %	**first**	***lmg***	**first**	***lmg***	**first**	***lmg***	**first**	***lmg***
Breed group	24.26	27.14**	24.55	26.98**	21.77	23.15**	18.59	18.70*
Role	17.36	16.68*	23.34	26.81*	17.40	16.79*	21.16	24.35**
Source	16.93	15.21*	21.64	19.70*	17.99	17.40*	20.80	20.02*
Weight	10.35	11.97*	4.64	5.20*	10.81	14.38*	7.24	10.14*
Age of other household dogs	8.93	9.51*	6.81	6.99*	8.66	8.62*	8.69	10.31*
Neuter reason	6.10	4.47	8.34	6.68*	7.80	5.89*	9.56	6.59*
Neuter status	5.18	2.28	4.60	2.25	6.58	3.53	7.85	4.56
First dog owned	6.32	6.33*	1.43	1.00	6.33	6.84*	2.15	1.65
Age when acquired	1.25	0.81	3.16	2.05	1.08	0.89	2.87	1.80
Age	1.96	3.94	1.13	1.83	0.82	1.50	0.24	0.59
Neutered age	0.34	0.31	0.31	0.39	0.31	0.48	0.36	0.43
Health problems	0.36	0.50	0.01	0.05	0.24	0.32	0.08	0.15
Sex	0.21	0.53	0.00	0.03	0.00	0.04	0.26	0.59
Owned dog as a child	0.46	0.32	0.05	0.03	0.22	0.16	0.15	0.12

** The largest predicting factor
* Factors that contribute over 5% to the variance observed in fear responses to veterinary examination, new situations, non-social fear and touch sensitivity, and are discussed in text

2.3.2.1. Breed group

Breed group was the largest predictor of fearful behaviour at the veterinary clinic (Table 3). Relative to the other breed groups, Table 2 shows toy breeds (*B* = +0.38), mixed breeds (*B* = +0.32) and hounds (*B* = +0.30) predicted the highest scores of fear when examined by a veterinarian. The utility (*B* = -0.01) and gundog (*B* = 0) groups exhibited the least fear during veterinary examination. The same breed group patterns are observed in the corresponding touch sensitivity subscale. However, when assessing fear of unfamiliar situations, mixed/unknown breeds (*B* = +0.28), hounds (*B* = +0.20) and working dogs (*B* = +0.18) displayed the highest scores of fear, while terriers (*B* = -0.02) and gundogs (*B* = 0) exhibited the least fear in new situations. The highest levels of non-social fear were observed in mixed breeds (*B* = +0.17), and hounds (*B* = +0.12), while the lowest non-social fear scores were displayed by utility (*B* = -0.004) and gundogs (*B* = 0).

2.3.2.2. A dog's employment or activity history

The activities or roles a dog has been involved in are the second largest predictor of fear of veterinary examination (16.68%) and fear of new situations (26.81%), and the most important predictor of non-social fear (24.35%; Table 3). Relative to all roles or activities (Table 2), dogs used for breeding and showing (*B* = 0) and dogs with a working background (*B* = -0.08) predicted the lowest scores of fear when examined by the veterinarian. Conversely, companion dogs (with no history of formal roles or activities) predicted the highest scores of fear when examined by a veterinarian (*B* = +0.26). Dogs involved in other sports (*B* = +0.13), and field trials or hunting (*B* = +0.13) also tended to exhibit more fear during veterinary examination than working dogs. The same trend was observed in the corresponding touch sensitivity subscale, with companion dogs displaying the highest scores of fear (*B* = +0.15), and those in working roles the least fear (*B* = -0.06). Similarly companion dogs were likely to exhibit the highest fear responses in new situations (*B* = +0.19), and non-social fear (*B* = +0.14), while again, dogs in working roles showed the least fear (*B* = -0.16; *B* = -0.13 respectively).

2.3.2.3. Source of the dog

The source of the dog was also a large predictor of fear response across all dependent variables (Table 3). Dogs acquired from a breeder (*B* = -0.02) or bred by their guardians (*B* = 0) predicted the lowest fear scores when examined by a veterinarian (displayed in Table 2). Whereas, dogs acquired from a friend or relative or purchased from a pet store predicted the highest fear scores (*B* = +0.24; *B* = +0.22 respectively). Dogs acquired from a friend or relative were also likely to have higher scores in the touch sensitivity scale (*B* = +0.21), followed by those acquired as a stray (*B* = +0.20), those from a shelter or rescue (*B* = +0.18) and those from a pet store (*B* = +0.16). A slightly different trend is observed in fear of new situations and non-social fear. Dogs acquired from a friend or relative (*B* = +0.18), or as a stray (*B* = +0.17) displayed the highest scores of fear in new situations. In contrast, the highest non-social fear was exhibited by dogs purchased from a pet store (*B* = +0.22), followed by those from a shelter or rescue (*B* = +0.19). Dogs purchased from a breeder were the least fearful of unfamiliar situations (*B* = -0.004), while dogs bred by their guardian had the lowest touch sensitivity and non-social fear scores (*B* = 0).

2.3.2.4. Weight

A dog's size also contributed over 5% of the variation observed in fear response (Table 3). Larger dogs (>22kg) exhibited lower fear scores in comparison to smaller dogs (<22kg) when examined by a veterinarian (*B* = -0.17) and in new situations (*B* = -0.09), and had lower touch sensitivity (*B* = -0.13) and non-social fear (*B* = -0.14; Table 2).

2.3.2.5. Age of other household dogs

The ages of other dogs in the home also influenced a dog's fear response (Table 3). Dogs living without conspecifics displayed the most fear across all dependent variables (*B;* Table 2), except fear of unfamiliar where dogs living with older dogs (*B* = 0.01), or dogs older and the same age (*B* = 0.03) predicted slightly higher fear in that context. Conversely, dogs that lived with other dogs that were older, younger and the same age (e.g. living with at least three other dogs) showed the lowest scores of fear during veterinary examination (*B* = -0.22) and in the touch sensitivity (*B* = -0.15) and non-social fear (*B* = -0.18) subscales. Whereas, dogs that lived with others that were younger and the same age showed the least fear in new situations (*B* = -0.15).

2.3.2.6. Other contributing factors

The reason a dog was neutered also contributed to the variance of fear observed across the majority of variables, but did not contribute over 5% of variance toward fear of veterinary examination (Table 3). Dogs neutered in order to correct behaviour problems exhibited the highest scores of fear in new situations (*B* = +0.12; Table 2), touch sensitivity (*B* = +0.12) and non-social fear (*B* = +0.05). Conversely, dogs neutered for unknown reasons displayed the lowest scores of fear in new situations (*B* = -0.13) and in touch sensitivity (*B* = -0.09). Lastly, the guardian's experience in owning a dog predicts a small proportion of fear observed during veterinary examinations and in touch sensitivity (Table 3). First time dog owners had dogs that exhibited the highest scores of fear during veterinary examination (*B* = +0.16; Table 2), and in touch sensitivity (*B* = +0.12), in comparison to guardians that had owned dogs previously.

2.4. Discussion

A large sample size of companion dogs was used to explore the proportion and characteristics of dogs that show a fearful response when visiting a veterinary clinic and in unfamiliar situations. According to their guardians, 41% of dogs experienced mild to moderate fear when examined by the veterinarian, while one in seven dogs (14%) exhibited severe or extreme fear in the same context. Likewise, 47% of companion dogs exhibited mild to moderate fear in new situations, including the first time at the veterinary clinic, while 11% exhibited severe-extreme fear. These figures fall within the broad estimates of previous cross-sectional studies [1, 2, 4, 5, 8-12, 14] and arguably provide a more realistic rate of global prevalence of fear of the veterinarian in dogs. In contrast, the touch sensitivity and non-social fear subscales demonstrated a smaller proportion of companion dogs exhibiting fear in some capacity (35% and 37% respectively).

The individual items likely measure a wide range of fearful behaviours in dogs visiting a veterinarian as they correlated with different behavioural subscales (touch sensitivity and non-social fear). This is supported by the positive moderate correlation between the two items (fear of veterinary examination and fear of unfamiliar) and the two subscales (touch sensitivity and non-social fear). It suggests that while there is some overlap across dependent variables, each individual dog's fear response differs slightly according to context. Fear of veterinary examination likely reflects the association made with handling and potentially painful experience in a clinical setting, while fear of unfamiliar situations (including first time at the veterinary clinic) could reflect a generalised neophobic response. The reduced prevalence of fear in the subscales (in comparison to the two individual items), indicates the more general nature of touch sensitivity and non-social fear. That is, while the subscales include items referring to a dog's veterinary experience, the scales also contain other items that do not. As such, the higher prevalence of fear observed in the individual items reflects the many factors within the veterinary context that may be the cause or catalyst of that fear.

The prevalence of fear in a veterinary context may be influenced by a dog's genetic predisposition to fear [44]. For example, Godbout et al. [3] identified a small proportion of puppies (10%) that displayed extreme avoidance behaviours during a mock examination. They suggest this likely reflects a proportion of dogs that exhibit anxious behaviours through to adulthood, as a result of a genetic predisposition to an anxious temperament. This is an important area for future research and our results indicate a similar proportion of dogs with severe fear.

As a group, all predictors explained between 5 and 7% of variance in fear of unfamiliar and fear of veterinary examination. The most important predictors were, in order, the dog's ANKC breed group, the dog's employment or activity history, where they were sourced, their weight, the age of other dogs in the household, reason for neutering and guardian's level of experience of dog ownership. The low effect size (i.e. 7% for fear of veterinary examination) suggests these factors combined set the foundation of a dog's predisposition to fearful experience in the veterinary clinic, while other influences (e.g. environmental, previous experience or human-animal interactions) pinpoint the severity of the fear response. This mirrors previous studies investigating neuter age and stranger-directed aggression [29] or fear-related behaviours [30], source of acquisition and non-social or stranger-directed fear [45], and litter size and personality [46]. Indeed, Casey et al. [47] suggest the factors associated with human-directed aggression explain a similar amount of variance (<10%), and emphasise that individual experience is likely of much greater importance in determining behaviour. Thus, while these risk factors are invaluable in helping inform opinion on how a dog may respond in a veterinary clinic, we emphasise the importance for veterinary staff to take active steps to prevent negative experience from developing in the first place. Edwards et al. [48] provides a summary of current strategies thought to reduce or prevent distress in the veterinary clinic, while Dawson et al. [49] have developed a canine and feline welfare assessment tool that can assist clinics in determining their overall score for pet-friendly practice.

A dog's breed is frequently attributed to variance in behaviour, and as such, it may be unsurprising that breed group was the best predictor of fear across all the dependent variables. Blackwell et al. [50] reflect that mixed breeds, according to their guardians, were generally more likely to be fearful of noises in comparison to other breed groups. In contrast, in a cross sectional study, dogs in utility and hound groups were more aggressive to family members than mixed breeds [47]. Although this may simply highlight the difference between aggression and fear, it suggests context is important in determining behaviour – the same dog may react fearfully to an unexpected noise but aggressively toward an unfamiliar person. Additionally, some individual breeds (e.g. dachshunds, Chihuahuas or Jack Russell terriers) have been associated with an increased likelihood of showing aggression toward their guardians and strangers [31]. However, comparison across the literature is difficult due to unstandardised methods (e.g. subjective survey or objective experimental design), breed definitions (e.g. conventional breed grouping or genetic cluster) and behaviour or trait analysed [51]. Breed-specific behaviour then, likely varies from a combination of genetics, early experience and the current environment; nature via nurture [51-53]. Indeed, breed differences may simply reflect features the breed has been specifically selected for (and not all aspects of behaviour), and emphasise the impact of early experience for breeds typically raised in different environments [54]. It is also important to note that while it may provide a predisposition to fear, temperament emerges early in development and remains relatively stable across situations and over time [55]. In contrast, fear of veterinary care likely incorporates a learnt component as dogs can associate adverse veterinary experiences with the veterinary clinic, and are learning to anticipate the negative experience in subsequent visit [4, 56]. Dawson et al. [49] suggests there is considerable variation between veterinary clinics and their practice or approach to animal welfare. Therefore it stands to reason that where the approach differs, so does the dog's fear response. Considering a dog's ANKC breed group explained the largest proportion of variance of fear observed, extending the veterinary consult, or providing extra support to guardians of specific breeds may be valuable in reducing fear in the veterinary clinic. However, active steps should be taken to prevent negative experience in the first place regardless of breed.

In the present study, dogs previously employed in working, breeding and showing roles had lower fear of the veterinarian and fear of unfamiliar, while companion animals were most likely to show high levels of fear in the same contexts. This is supported by dogs in these roles also having the lowest touch sensitivity scores. The roles that dogs are employed in can influence aspects of their personality and behaviour, further highlighting the contention between inter- and intra-breed variation in behaviour. For example, Lofgren et al. [26] argues that Labrador retrievers purchased as companions or employed in a gundog role showed higher human and object fear than Labradors that were show dogs, while companion Labradors exhibited greater noise fear than those that were gundogs or show dogs. The reduced risk of fear of veterinary exam and unfamiliar in dogs employed in breeding or working roles may reflect an increased familiarity with procedures associated with veterinary care (i.e. grooming, handling or restraint). As such, we suggest that appropriate handling and grooming practice for companion dogs is equally as important as basic manners training and socialisation in reducing fear in the veterinary context.

The source of acquisition of the dog was also a predictor of fear response in a veterinary context. Dogs acquired from friends or relatives, pet stores shelters and rescues, or as strays were most likely to be fearful during veterinary visits or have high touch sensitivity and non-social fear. In contrast, those bred by their guardian exhibited less fearful behaviour. This reflects a similar finding by Blackwell et al.[50], that dogs bred by their guardians are less likely to show fear responses to noises than dogs from other sources. Further, puppies from pet stores had increased risk of behavioural issues in comparison to puppies purchased from breeders [45, 57], while the quality of maternal care can have long term behavioural fallout and alter the physiological responses to stress [44, 58]. That is, dogs bred by their guardians may reflect a higher level of both maternal and guardian care and/or appropriate socialisation and early experience in the first few weeks of life in situations where guardians know they are keeping a puppy from a litter. In addition, it may also reflect a negative influence of transitioning to new homes in general, or more specifically, a negative experience *while* transitioning to a new home (i.e. plane travel, long distance car rides, lack of familiarity, early separation or being unfamiliar human contact). Indeed, guardians reported a significantly higher risk of destructiveness, excessive barking, fearfulness, reactivity to noises, resource guarding and attention-seeking behaviour in dogs that were separated from their litter before six weeks of age in comparison to those separated at eight weeks [59]. Therefore, the puppy's experience for the first several weeks of life requires careful consideration in future investigation of how dogs experience their veterinary visits. Veterinary staff and guardians alike can capitalise on the impact of this critical early period by limiting early negative experience and maximising early positive experience in the veterinary clinic.

Dog size also influences the overall variation of fear observed during veterinary examinations, with lighter (and therefore generally smaller) dogs (<22kg) predicting higher fear scores than heavier dogs (>22kg). Smaller dogs have also been found to be more vocal during observation on the floor of the veterinary clinic than larger dogs [3], and are associated with aggressive and excitable, and anxious and fearful behaviour in comparison to larger dogs [60]. Guardians of small dogs behave differently when it comes to allowing off lead play or socialisation in comparison to guardians of large dogs [61], and so it is possible that smaller dogs are treated differently when it comes to handling or grooming practice in comparison to their larger counterparts. Alternatively, the majority of dogs exhibit fear-related behaviour when examined on the examination table [4], so it is likely that the greater fear response observed for smaller dogs simply reflects a fear of the examination table. Either way, one way to reduce fear may be to examine dogs (of all sizes) on the floor or where they are most comfortable. It must be noted however, that the statistical models estimated the effect for breed when controlling for size and vice versa. As such, the extent to which each of the factors contribute to fear of veterinary examination and fear of unfamiliar individually is unknown, and likely inseparable, considering artificial selection for breed phenotype includes size.

Dogs living in single dog households were likely to exhibit higher fear in almost every scenario (fear of veterinary exam, touch sensitivity and non-social fear), while dogs living with others older, younger and the same age were the least fearful in those same contexts. The different trend observed in fear of unfamiliar may reflect the range of situations the question proposes, of which fear during the first time at the veterinary clinic is only one. While it may be simpler to compare singleton to multi-dog households, we emphasise that there was a significant effect of ages of other dogs in the household, and not simply living with conspecifics, that predicted lower fear in the veterinary context. This highlights the complexity involved in the social dynamic of living with other dogs *and* the nuance of different ages other dogs have on veterinary experience, relative to single dog homes. Perhaps it's the ages of other dogs in the home that influences social learning – younger dogs may learn from older dogs via observation, or dogs of the same age by participation. Living with multiple dogs of different ages may provide the social cues for confidence relating to fear during veterinary examination, or alternatively greater resilience generated by unpredictable and frequent social interaction observed within a multi-dog household. While dog age was not a predictor of fear relative to other factors in the present study, Doring et al. [4] identified dogs under two years of age exhibiting less behavioural signs of fear than middle-aged or older dogs. As with the benefit of a positive guardian presence in reducing fear [12], dogs that attend the veterinarian with another familiar, younger (< 2 years) and confident dog may take their social cues from that dog and be less fearful. It is unclear however, whether all dogs in the home attend the veterinarian together (and whether they show similar fear responses), or whether a reduced risk of fear at the veterinary clinic results from some social interaction that occurs at home. As such, the true impact of this factor as a predictor of fear in the veterinary context is difficult to discern. It is likely though, that guardian or conspecific presence is beneficial, but conditional on the type of attachment [62]. Further investigation into the dynamic nature of such relationships and in which environment (e.g. home or veterinary clinic) they are most effective in is required.

Guardian level of experience was another contributing factor for fear of veterinary examination and touch sensitivity. Guardians that had never owned a dog previously were more likely to have dogs that exhibited higher fear responses. While over 25% of guardians are able to identify obvious signs of stress in dogs [63], Flint et al. [64] suggest a lack of experience in dog behaviour or attendance at dog training classes is associated with guardians being less likely to identify fear correctly. This suggests a potential for fear to be under-reported in dogs with inexperienced guardians. It also constitutes a significant risk to companion animal welfare as accurately recognising fear is essential in reducing fear in the veterinary context [56, 65-68]. Further, while responses from single-dog households may also correlate with first-time dog guardians, the social dynamic involved in dogs living with other dogs of varying ages outweighs guardian experience when predicting fear during veterinary visits. Overall, the very real value of both guardian experience and age of other dogs in the household highlight the importance of guardian education focusing on canine socialisation and body language to increase their ability to accurately identify overt signs of stress as a minimum.

Guardians that neutered their dog in order to correct behaviour problems had dogs that were more fearful in new situations, and had higher touch sensitivity and non-social fear. This is supported by Lind et al. [14] who found that dogs with guardian reported behaviour problems were also rated as more stressed during veterinary visits by the guardian, and the (blinded) researcher. However, the cross-sectional design of the present study, and that of Lind et al. [14] is limited in that it may reflect dogs that already have behavioural problems, and hence are neutered, are then more likely to be touch sensitive and have non-social fear. Further longitudinal studies are necessary to investigate the influence of neutering on dog behaviour.

While the C-BARQ is a validated questionnaire that clearly describes the behaviour of interest, it is vulnerable to measurement errors, including: conservative reporting (if guardians are predisposed to report on items like problem behaviours optimistically); guardian interpretation of the items or behaviours; guardians not noticing behaviour during previous veterinary visits, and; time since last veterinary visit. The present study did not include dog location, and so the impact of cultural differences in dog ownership and veterinary experience are unknown. Further, the ability of guardians to accurately identify fear in their own dogs is questionable [9, 63, 64]. Indeed, while Flint et al. [64] found training in recognising fear in dogs resulted in guardians being more likely to correctly identify mild/ moderate and high/extreme fear, they observed no corresponding change in reporting on the guardian's rating of their own dogs. This calls to question the accuracy of guardian reporting of fear within C-BARQ, but also highlights the need for further investigation into what is required to ensure guardians are able to accurately identify fear in their own dogs. Conversely, while the current study's sample size is large, it may reflect responses from guardians that actively seek to know more about their dog's behaviour, and so, may represent responses from those who are more aware of their dog's fear or body language. Further, we suggest that the proportion of dogs exhibiting fearful behaviour in the context of unfamiliar situations may be over-representative of experience in the veterinary clinic, as guardians may be reporting on fearful behaviour that occurs in unfamiliar circumstances outside of the veterinary clinic. Future research into dog experience in the veterinary context should corroborate C-BARQ responses for dogs who have recently visited a veterinarian with physiological measures of fear or distress and objective observations.

Overall, it is important to emphasise that the proportion of dogs negatively experiencing their veterinary visits is likely to be under-represented by C-BARQ respondents. The items (fear of veterinary examination and fear of unfamiliar situations) within C-BARQ explicitly reflect fear responses only, with no corresponding items for aggression. Aggressive behaviour in the veterinary clinic is also a very real risk for dogs distressed during their veterinary care [67].

While several aggression items do refer to grooming or handling by an unfamiliar person (Q14, Q21), they do not expressly mention the veterinarian or veterinary clinic and so were not included in analysis in this study. As such, guardian responses only reflect fear in the veterinary context and it is highly likely guardians with dogs that behave aggressively at the veterinary clinic are not represented in the proportion of dogs experiencing distress during veterinary examination or in unfamiliar situations.

2.5. Conclusion

The results from the present study indicate that around half of companion dogs are experiencing some level of fear when receiving veterinary care, including one in seven dogs that show severe or extreme fear. The dog's breed group, the roles or activities they have been involved in, where they were purchased from, their weight, the age of other dogs in the household and the guardian's level of experience owning a dog accumulate to predict approximately 7% of the variation of fear observed during veterinary examinations. The same factors group together to predict 5% of fear of unfamiliar situations, 9% of touch sensitivity and 8% of non-social fear. While these factors play an important role in determining dog experience in the veterinary context, it is likely that other influences, such as the environmental set up of the veterinary clinic, history or past experience at the clinic, and the human-animal interactions (of guardian and veterinary staff), determine whether a dog shows fear at the veterinary clinic. It is important that the cause of fear in dogs visiting veterinary clinics be explored in more detail. For example, determining whether fear is a response to a previous negative experience in a clinic, or whether veterinary clinics are inherently stressful will help inform strategies that reduce distress during veterinary visits. Further investigation of how an individual dog's background or the current veterinary environment combine with these risk factors is essential to bettering our understanding of a dog's veterinary experience and in contributing to the continual improvement of dog welfare in the veterinary context.

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Chapter 3

At the Heart of a Dog's Veterinary Experience: Heart rate responses in dogs vary across a standard physical examination

Introduction

Chapter 2 indicated that fear of the veterinary clinic is likely to be a result of environmental or effects of handling or interaction, or previous experience and learning, rather than a genetic predisposition. The study in Chapter 3 investigates physiological and behavioural responses to a routine physical examination in a mock veterinary setting. Using a mock setting meant that responses were not confounded by previous experiences in the same setting, or the sights and smells in a real veterinary clinic which may trigger fear. This cross-sectional study observed 35 healthy, privately owned companion dogs of various age, breed and sex undergoing a standardised physical examination and recorded the heart rate (bpm) and behavioural responses at each stage. This Chapter builds on current understanding and offers unique insight into the impact simple handling procedures may have in influencing a dog's fear within the veterinary context.

Statement of Authorship

Title of Paper	At the heart of a dog's veterinary experience: Heart rate responses in dogs vary across a standard physical examination
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Principal Author

Name of Principal Author (Candidate)	Ms. Petra Edwards		
Contribution to the Paper	Conception Acquiring Data Knowledge/ Methodology Analysis Drafting Reviewing & Editing		
Overall percentage (%)	70%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	01/04/2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Abstract

Regular veterinary care is integral to companion dog health and welfare, but fearful patients can inhibit provision of care and pose a risk of injury to veterinary staff. This study aimed to identify the physiological and behavioral responses of a sample of 30 dogs of various age and breed, to a standardized physical examination in a simulated veterinary setting. Fear was measured using heart rate (HR; beats per minute (bpm)) and continuous behavioral observations during each stage of the consult. Average heart rate increased significantly from waiting room (97.7bpm ± 19.6 bpm) to consult room (123.5bpm ± 21.2 bpm; p <0.001). Approximately one third of the dogs (11/30) had heart rates peak over 180bpm at some point during their physical examination while they were at rest, with the maximum heart rate recorded at 230 bpm. Heart rate differed significantly between female (n = 21; 129.0bpm ±26.5 bpm) and male dogs (n= 9, 110.0 bpm ±21.2bpm; p = 0.015); and between individual steps of the physical examination (p < 0.001). The first step, being patted by the examiner (138.0bpm ± 25.2bpm), and the last step, a simulated vaccination (133.8bpm ±28.7bpm) elicited the highest heart rate responses, while the teeth examination had the lowest (109.6bpm ± 28.7bpm). The proportion of time a dog spent with their tail tucked between hindlegs (n = 29, r = 0.392, p = 0.032) and ears positioned backwards (n = 29, r = 0.453, p = 0.012) were moderately correlated with increasing heart rate. The results suggest that undergoing a simulated physical examination, even in a mock veterinary setting, can be a stressful experience for dogs, and importantly varies according to the individual dog and the stage of the examination. Veterinarians should be aware how much heart rate can vary during a physical examination and a single point measure can be misleading, and that behavioral signs such as tail tucked and ears back may suggest fear related to different steps of the physical examination.

3.1. Introduction

The welfare of domestic dogs is dependent on regular veterinary visits, and while many cope well with their veterinary care, others find these visits distressing. Approximately 41% of 26,555 guardians (owners) around the world report their dogs show mild to moderate signs of fear when examined by a veterinarian, and 14.2% report their dogs experience severe or extreme fear in the same context (Edwards et al. 2019a). Volk et al. (2011) estimate up to 38% of guardians in North America believe their dog 'hates' their veterinarian, and 26% become stressed even thinking about taking their dog to the veterinary clinic. Fear-related behaviors and arousal can lead to behavioral escalation to aggression (Moffat 2008; Shepherd 2009; Yin 2009; Overall 2013; Rooney et al. 2016; Lloyd 2017), resulting in risk of injury to veterinary staff. In addition, physical restraint is often required in veterinary practice, yet it increases physiological and behavioral signs of fear (Grandin 1998a, 1998b; Moberg 2000; Gregory 2004). Further, physiological and behavioral signs of fear in dogs present as similar to those of pain or illness (Frank 2014), which can lead to inaccurate or missed clinical diagnoses. As such, dogs that become stressed or fearful when visiting veterinary clinics, regular check-ups or chronic health conditions can become problematic in both disrupting the quality of veterinary care provided, and increasing risk of injury and the likelihood of a guardian hesitating before booking a consultation. Understanding how dogs experience veterinary care is important for ensuring interventions to reduce stress and safety for both dogs and veterinary staff.

Döring et al. (2009) found dogs with previous negative experience were more likely to be fearful in the current visit, even if the visit was 'positive' in nature. In humans, 'bad' experiences are considered much stronger and more salient than 'good' experiences (Baumeister et al. 2001), and negative emotions affect the way individuals recall events (LeBlanc et al. 2015). Further, Storbeck and Clore (2008) suggest valence affects how an individual values an experience, while arousal (e.g., fear) determines its urgency. In humans, a cognitive bias in memory recall is described by the Peak-End Rule, in which, for example, people do not remember all of a 30minute experience but are able to recall the most intense and last part of the experience (Kahneman et al. 1993). Dogs may similarly be more likely to recall the most emotionally intense and final aspects of their veterinary experience. It is also important to consider how experience is shaped by learning. Research on the salience of negative versus positive experience in dogs is lacking, and although peer-reviewed evidence is needed, reports suggest dogs can learn to anticipate an unpleasant experience based on the veterinary context (Döring et al. 2009; Overall 2013). Animals build associations between environmental stimuli and future behavior is shaped by consequences (Thorndike, 1927; Skinner, 1965; Chance, 2009). A perpetual cycle of negative experience in the veterinary clinic is unlikely to be ameliorated without intervention. To that end, strategies to mitigate fear and stress within the veterinary context are recommended in an attempt to prevent the potential cycle of negative experience. Such strategies are comprehensively discussed in reviews (Lloyd, 2017; Edwards et al. 2019b; Riemer et al. 2021). Many techniques implemented to reduce fear of the veterinary clinic involve the use of food for distractions or counter-conditioning, and training (Westlund, 2015; Howell & Feyrecilde, 2018; Jones, 2018). Yet, the evidence of the efficacy of such interventions in clinical practice is lacking. Gaining a greater understanding of which experiences within the veterinary context are most salient from a learning and memory perspective is valuable in informing the direction of future research for the continual improvement of companion dog welfare.

Previous studies investigating how dogs cope with their veterinary care have employed physiological (heart rate, heart rate variability, salivary cortisol, rectal temperature, respiratory rate, blood pressure maximal ocular surface temperature, and urinary corticoid: creatinine ratio) and/or behavioral measures (Stanford 1981; Van Vonderen et al. 1998; Väisänen et al. 2005; Godbout et al. 2007; Hernander 2008; Döring et al. 2009; Hekman et al. 2012; Csoltova et al. 2017; Lind et al. 2017; Mariti et al. 2017; Stellato et al. 2019a; Hauser et al. 2020). For instance, Väisänen et al. (2005) found 30.7% of 41 dogs showed heart rate and behavioral signs of stress when confined without their guardian present, and Csoltova et al. (2017) reported significant increases in heart rate during examination and post-examination in comparison to the pre-examination phase. Stellato et al. (2020) also observed female dogs had significantly higher heart rate in the 'owner absent' group during a physical examination compared to males in the same group, and both sexes in the 'owner present' group. However, neither Csoltova et al. (2017) or Stellato et al. (2020) reported on heart rate across different phases of the physical examination. Guardian or expert ratings based on dog body language have been also used as a measure of fear or stress in companion dogs in veterinary clinics (Mariti et al. 2017). However, the ability for guardians to accurately identify signs of fear in their own dogs, even after educational intervention, appears limited (Flint et al. 2018). Much of the current literature also focuses on the clinical environment or interventions aimed toward reducing fear at the veterinary clinic, including: the influence of examining dogs on the table (versus the floor; Döring et al. 2009), the presence or interaction with guardians (Csoltova et al. 2017; Stellato et al. 2020), the use of classical music (Engler & Bain 2017; McDonald & Zaki 2020), pharmaceutical intervention (Gilbert-Gregory et al. 2016; Gruen et al. 2017; Hauser et al. 2020); pheromones (Mills et al. 2006; Kim et al. 2010; Siracusa et al. 2010) or background noise (Stellato et al. 2019a). For instance, Csoltova et al. (2017) report dogs whose guardians interacted with them in a positive manner were significantly less likely to attempt to jump off the examination table in comparison to dogs whose guardians did not interact. Whereas, Stellato et al. (2019a) suggest the phase of the examination (e.g., head, body, etc.) has a greater effect on behavioral responses of fear than general clinic background noise. Yet, these studies have been conducted within a veterinary clinic, or in rooms previously used in clinical research. Dawson et al. (2016) and Edwards et al. (2019b) suggest there are likely to be many aspects of the veterinary visit and/or veterinary clinic that dogs associate with fear. It is also likely individual triggers (e.g., the sights, sounds, smells, and human or animal interactions) stack up as physiological responses to stress are unable to return to baseline before the presentation of the next trigger (Edwards et al. 2019b). Understanding the catalyst of fear or stress responses (e.g., stages of a physical examination or aspects of the veterinary environment) in dogs during their veterinary visits is vital in developing effective strategies to reduce fear. While existing literature predominantly focuses on investigating fear responses during veterinary care procedures within a veterinary clinic, separating the influence of environmental factors (e.g., clinic-specific sights, sounds or smells) and care-related experiences (e.g., handling or interactions with others) is challenging. The ability to measure the effect of a routine veterinary care procedure in a non-clinical environment allows these different stressors to be separated. Therefore, the aim of the present study was to investigate how dogs respond physiologically and behaviorally to different aspects of a physical examination within a simulated veterinary clinical environment.

3.2. Methods

3.2.1. Participants

A total of 35 Adelaide (South Australia) based guardians and their dogs were recruited via social media (dog training clubs, dog support groups, The University of Adelaide social media groups), and poster advertisements at The University of Adelaide School of Animal and Veterinary Sciences and local veterinary clinics. Guardians initially volunteered to participate by completing an online survey including contact details, guardian availability and dog eligibility. Guardians were then contacted via email with a testing location and time. Dogs were over 6 months of age, with no history of aggression during veterinary visits (as reported by their guardians in response to an initial 'opt-in' survey) and no illness or medical condition that would cause pain. Dogs were excluded from the study if they usually required anxiolytic medication to attend their veterinary clinic, although dogs that were on medication for generalized (or other) anxiety were included, as the medication is administered regardless of veterinary attendance.

3.2.2. Testing procedure

Testing was conducted over eight days on weekends between March-May 2019, with each dog and guardian spending approximately one hour in total on site. Testing was conducted in university teaching spaces (approx. 10m by 12m in size) at two locations in South Australia: CQUniversity Adelaide Campus, and The University of Adelaide Roseworthy Campus. Testing locations were set up to simulate a 'normal' veterinary experience with empty 'waiting room' and 'consult room' separated by a short walk. Dogs were scheduled to attend 1.5 hours apart to avoid any cross-over risk associated with meeting other dogs prior to testing.

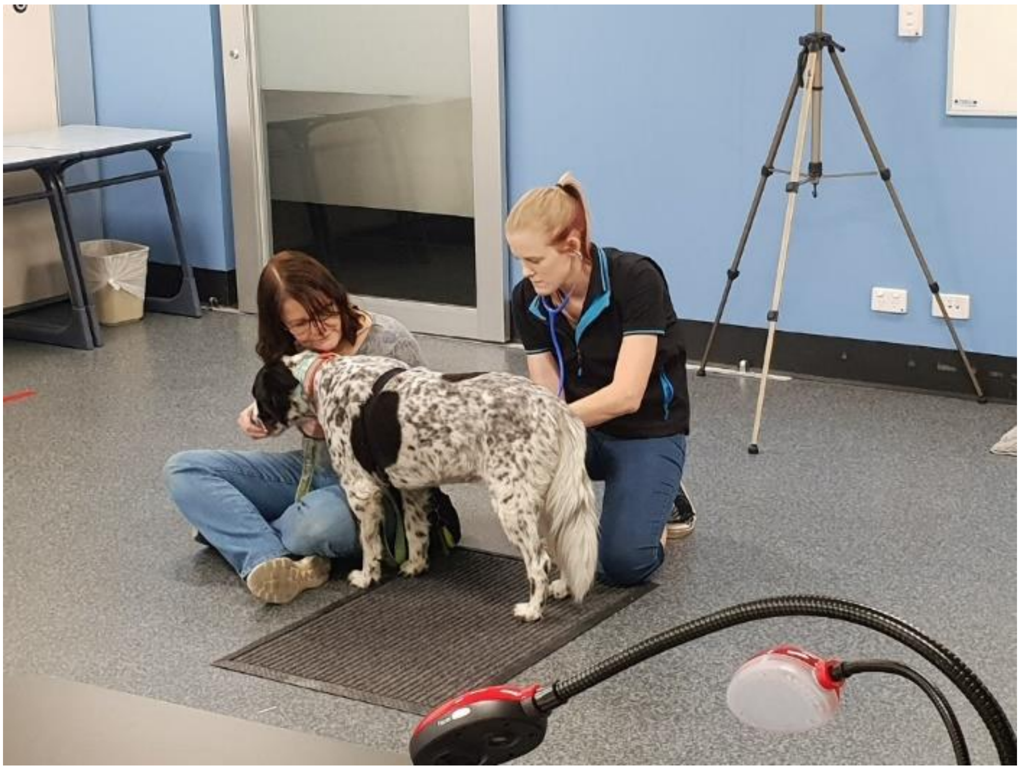
Guardians and dogs were video recorded in both the waiting room with a Movii Neo Camera (TechBrands, New South Wales, AUS) and consult room Panasonic® Lumix (Panasonic Corporation, Osaka, Japan), GoPro® Hero (GoPro Inc., California, USA) and Sony® Camera (Sony Corporation, Tokyo, Japan). In the consultation room, three cameras were positioned in front of, and at each side, of the examination location to ensure the dog could always be observed regardless of guardian or examiner presence.

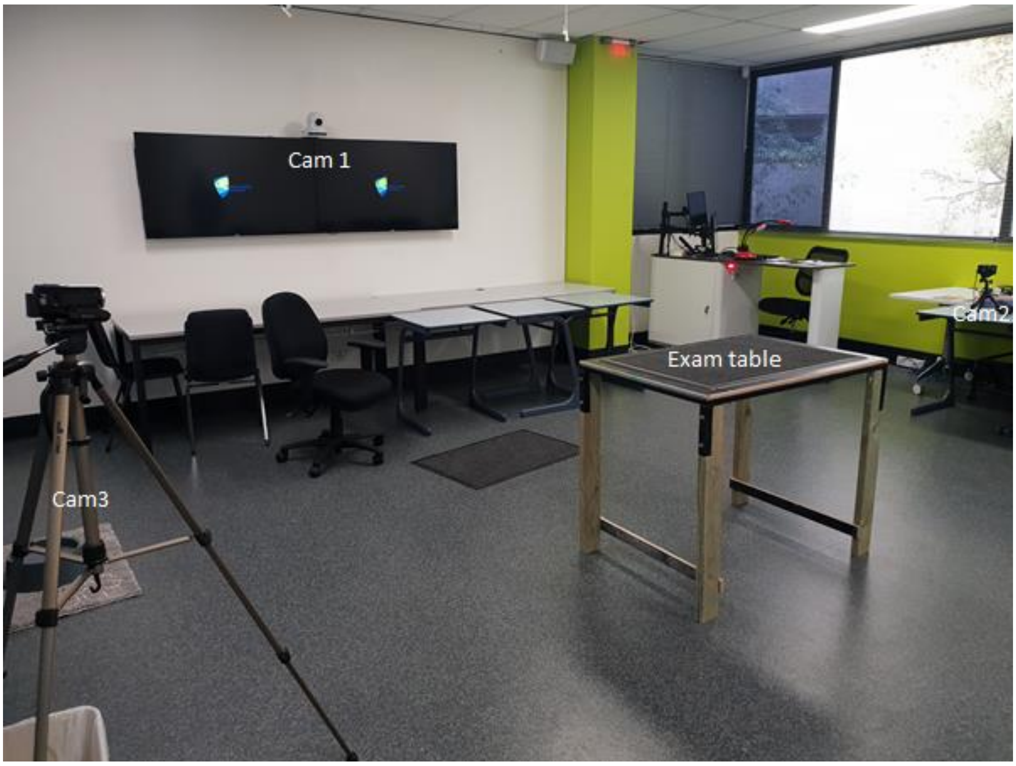
3.2.2.1. Pre-Examination Procedure (Waiting Room)

Upon arrival, dogs were shown into the 'waiting room' and the heart rate monitor was attached using Aquasonic®100 Ultrasound Transmission Gel (Parker Laboratories, New Jersey, USA). Heart rate for the waiting room was recorded for 29 dogs (an error in recording occurred for 1 dog). The H10 device was placed over the heart on the left side of the dog's chest, just behind the front legs (Figure 1a). Liver food treats were used to assist in placing the heart rate strap on the dog and while ensuring the connection was stable, after which the dog was left to habituate to the heart rate strap during the waiting phase. Researchers were able to get a reliable heart rate read from every dog attending, without shaving the fur, although some long-haired breeds (Shetland sheepdogs, golden retrievers) required copious amounts of ultrasound gel. The researcher observed the live read of the heart rate monitor (Polar M430 Watch) to ensure the connection was consistent (bpm displayed and changing frequently), after which the guardian(s) were left in the waiting room with their dog to complete an online survey. The waiting period concluded once the guardian had completed the online survey (mean (SD) duration: 15.2 minutes ±5.3 minutes).

3.2.2.2. Standardised Physical Examination Procedure (Consult Room)

The layout of the consult room at CQUniversity is displayed in Figure 1b (the set up at Roseworthy Campus mirrored this). A standardized physical examination was conducted by the same 'examiner' (a qualified and experienced veterinary nurse and dog training professional) for all dogs. The same researcher for all dogs remained unobtrusively in the consult room to ensure the heart rate connection remained consistent, and the dog did not become unduly distressed or escalate to aggression. In which case, the examiner and researcher halted the examination and allowed the dog to calm down. The wooden examination table was built to meet standard veterinary examination table dimensions (850mm high, 700mm wide and 1030mm long) with a non-slip mat. Prior to beginning, guardians were asked whether their dog was usually examined on the table or the floor during their normal veterinary visits, which dictated the examination location (table or floor) in the present study. Guardians were given instructions to interact with their dog as they normally would in a veterinary situation (e.g., empty waiting room, and consult room), which included allowing dogs to sit on their laps, feeding treats, or assistance in restraint.


a)



b)

Figure 1a): Dog 12 (male, mixed breed) with heart rate monitor strapped to chest, during Chest Sounds phase of physical examination. Guardian (left) and examiner (right) with stethoscope. **1b):** display of consult room set up at CQUniversity.

The physical examination was adapted from Csoltova et al. (2017) followed the standardized sequence of clinical activities outlined in Table 1, with a slight difference in 11 dogs in which the order for left or right was switched. The Mock Rectal Temperature and Mock Vaccination simulated actions used in reality. In the case of the vaccination, a syringe (sans needle) was pressed against the skin across the shoulder blades, and the tail was held for a rectal temperature without use of the thermometer. Each step in the physical examination was separated with a five second pause. At the end of the physical examination each dog was offered a liver treat.

The researcher started the heart rate recording at the same time as cueing the examiner to start the examination by counting down out loud. This enabled the video recordings to be retrospectively edited to start at 'Time 0' and allow for the accurate comparison of heart rate and behavioral responses. The times at which steps in the physical examination started and were completed were retrospectively coded through watching the video recordings. Clinical activities were deemed to commence at the first time the examiner touched the dog for that activity, and ceased once the examiner's hands left the dog's body.

Table 1: Sequence and description of clinical activities for completion of physical examination, with minimum time (s) required (no maximum was set). In 3 cases, a clinical activity was missed: Palpation (*n*=1); Teeth (*n*=2). Those marked with an '*' are included for context, but excluded in analysis of physical examination steps. Mean duration (standard deviation) of the time (s) taken to complete that step during the physical examination is also provided.

Order (label)	**Clinical Activity (minimum time)**	**Description of examiner procedure**	**Duration (s)** Mean ±Std.Dev.
1. Habituation* 2. Lift to table if applicable*	Habituation (1½ min)	Greet dog and offer treat. Allow to explore consult room while talking with guardian	105.4 ±27.6
3. Pats	3 x strokes from head to base of tail (5s)	Dog in any position	7.4 ±3.4
4. Pulse	Right thigh pulse point (30s)	Dog in any position, must be able to read pulse consistently	35.8 ±10.3
5. Chest Sounds	Chest Sounds using stethoscope (30s each side)		70.3 ±9.0
6. Palpation	Gentle abdominal Palpation (30s)		42.1 ±30.5
7. Right Front Leg (RFL)	Examine right forelimb (including paw) (5s)	Dog in any position, must be able to test range of motion and musculature, and inspect paw pads thoroughly	12.3 ±6.2
8. Right Back Leg (RBL)	Examine right hindlimb (including paw) (5s)		13.8 ±4.4
9. Left Front Leg (LFL)	Examine left forelimb (including paw) (5s)		12.3 ±4.0
10. Left Back Leg (LBL)	Examine left hindlimb (including paw) (5s)		12.4 ± 3.9
11. Right Ear	Examine right ear (5s)	Dog in any position while ear and ear canal inspected	9.9 ±2.4
12. Left Ear	Examine left ear (5s)		9.3 ±2.9
13. Mock Temperature	Simulate rectal temperature (30s)	Lift and hold tail, without thermometer. Dog must be standing.	36.0 ±9.0
14. Right Eye	Examine right eye (5s)	Dog in any position, must be able to inspect eyes and mouth thoroughly	10.2 ±6.2
15. Left Eye	Examine left eye (5s)		8.2 ±2.8
16. Teeth	Examine teeth and mouth mucosa (20s)		28.8 ±7.8
17. Mock Vaccination	Simulate vaccination (syringe, no needle) (5s)	Dog in any position, pinch, test and simulate vaccination on withers.	6.8 ±2.7
18. Treat*	Offer dog a liver treat (2s)		4.5 ± 2.0

A clinical activity in the examination was ceased if the dog: attempted to escape restraint (or the table) three times within that step; struggled to the extent the examiner would normally require a second veterinary staff member to assist in restraint; showed behavioral signs of escalation to aggression; or at guardian request. Clinical activities that were not completed for the above reasons were coded as a ‘fail’. Dogs (*n*=5) were excluded from the data analysis if they failed more than half of the physical examination steps. Some activities were coded as failed if the preceding activity was failed (e.g., examination of the Left Eye or Left Ear was ‘failed’ in some cases where behavioral escalation to aggression ceased examination of Right Eye or Right Ear).

3.2.3 Data collection

3.2.3.1. Guardian survey

The waiting room survey consisted of 33 questions regarding the guardian and dog’s demographics (*n*=14), training history generally, and about training for veterinary visits (*n*=3) and questions about their veterinary visits(*n*=16). Guardians were asked to report on their dog’s stress level throughout different aspects of the veterinary visit, using a five-point scale adapted by Overall (2013) from Hernander (2008). For example, Level 1 –No stress/fear (calm, relaxed and seemingly unmoved, or friendly, outgoing and seeks attention), Level 5 – Extreme fear (dog must be forcefully brought in). The frequency of guardian provision of food rewards to their dogs during the physical examination was coded retrospectively via the video recordings and used in analysis as presence/absence.

3.2.3.2. Physiological measure

A Polar® M430 Watch and H10 chest strap (Polar Electro, Kempele, Finland) was used to collect and record the heart rate data from each dog. Human Polar® heart rate devices have been validated against electro-cardiograms (ECG) in dogs previously (Jonckheer-Sheehy et al. 2012; Essner et al. 2013), and more recently used without validation to ECG (King et al. 2014). The data was exported from the online Polar® Flow portal to Microsoft Excel 2016 (Microsoft Corporation, Washington, USA) for analysis. The waiting room heart rate data had 100 seconds trimmed from the start and the end to remove bias associated with the researcher leaving or entering the room. Mean waiting room heart rate (bpm) was used as a baseline measure for comparison against heart rate for the physical examination. One case (Dog 34) had an inconsistent heart rate read in the waiting room and so the 180 consecutive seconds of reliable connection within the waiting room was used to calculate the average baseline for that dog.

Heart rate data was recorded continuously (every second) throughout the physical examination and so could be matched retrospectively to the correct times for each stage of the physical examination. Heart rate data that remained the same for 10 seconds or more in a step were removed, and the remaining heart rate for that step was used to calculate the heart rate average for that step (there were 10 instances of this from 7 dogs). In instances where a step was less than 10 seconds duration - if the heart rate did not change for the entirety of a step, that step was excluded (4 instances from 3 dogs) – these were coded as an heart rate Fail. Heart rate in the consult room was recorded from Time 0, to the end of the physical examination (offering of the liver treat).

3.2.3.3. Behavioral measures

An ethogram of behaviors (Table 2), was developed from previous literature (Beerda et al. 1998; Csoltova et al. 2017). Video recordings of behavior within the consult room were coded with CowLog software (Hanninen & Pastell 2009) from Sept 2019 to Jan 2020. Each dog's video recording was observed twice – once with a focus on head-centric behaviors, and then a focus on the rest of the body. Coding included frequency (behavioral events) and state (duration) behaviors. State behaviors were coded as mutually exclusive sets (e.g., EarsBack, EarsForward, EarsNeutral). Frequency behaviors were grouped into themes: avoidance; posture reduction; displacement; miscellaneous; vocalisation (similar to Stellato et al. (2019a) and Hauser et al. (2020)). Frequency and grouped behaviors can be found in Supplementary Information: Table

1, as they were not significant. The duration of each dog's physical examination differs slightly and as such, frequency behaviors are expressed throughout as frequency per minute, while state durations are expressed as the percentage of time the dog was in sight.

Table 2: Summary table of behaviours and their definitions observed during physical examination. Behaviours scored as a state (duration) with head or body focus, coded in mutually exclusive sets (e.g. EarsBack, EarsForward, EarsNeutral).

Focus	Behaviour	Description
Body	Tail Tuck	Tail at lower than normal (breed standard) carriage (can be wagging), tip of tail curved in toward belly, tip of tail in line with hock or past line of hock.
	Tail Neutral	Tail at neutral, mid-range height (for breed standard), most likely level or a little lower than rump, tail carriage relaxed
	Tail High	Tail higher than neutral (for breed standard), may be wagging at any speed
Head	Ears Back	Ears back or held lower than normal
	Ears Neutral	Ears held in a neutral, relaxed state
	Ears Forward	Ears held forward, open, higher than normal
	Mouth Relaxed	Mouth mostly closed, relaxed flews (lips), no tension around eyes/ face. Commissure of mouth relaxed line or slight V-shape
	Mouth Closed	Mouth fully closed, tense, tendons under eye seen
	Pant	Mouth open with tongue extended accompanied with rapid breathing and expansion / contraction of the chest. Commissure of mouth pulled into a C-shape, tense lips

3.2.4. Statistical Analysis

3.2.4.1 Physiological and behavioral analyses

All statistical tests were conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corporation, New York, USA). Heart rate data was normally distributed (Shapiro-Wilk $p > 0.05$), while most behavioral data was not normally distributed (Shapiro-Wilk $p < 0.05$). Parametric tests were conducted on all normally distributed data. Heteroscedascity in the heart rate residuals plot was addressed using a logarithmic transformation ($\log_{10}$) prior to further statistical analysis, although all graphic and tabular results provided display the un-converted heart rate data for ease of interpretation. A log likelihood ratio test with autoregressive model (to address the repeated measures nature of the physical examination) and Wald test were initially conducted to identify variables in the models which significantly influence a dog's heart rate during physical exam. As a result, a mixed linear model was conducted with a random factor variable of individual dog, and the fixed factor variables of: steps of the physical exam; dog sex; size; training for vet; guardian treat, and; examination location (e.g., floor or table). In this way, the model accounts for the repeated measures aspects of the consecutive steps of the physical examination, where mean heart rate for each step used in analysis accounts for the effect of varying duration of the whole procedure. Significance was set at the $p<0.05$ level and data are presented as mean ± SD unless otherwise stated.

The raw (.csv) behavioral data was parsed using the Practical Extraction and Reporting Language (PERL version 5.0; Wall 2021) to create correlated and consolidated spreadsheets mapping clinical activities to behavior frequency and duration for all dogs across the entire physical examination. The PERL coding rules used can be found in Supplementary Information: PERL Coding. A Pearson correlation was conducted to test the association between heart rate and behavior data. Non-parametric behavior data are displayed as median (min-max). A heart rate of 180bpm was used as a cut off for analysis as it is a sign of sinus tachycardia (Hackett, 2015). A Chi-square (Fishers Exact) test was used to assess the association between the failure rate (for steps where there were failures) across the physical examination and heart rate group (whether a dog's heart rate peaked above 180bpm or remained below).

3.3. Results

3.3.1. Descriptive results

Of the 35 dogs who participated in the study, five were excluded from analysis as they failed more than half of the physical examination steps. A summary of the 30 dogs included in data analysis is found in Table 3. The majority of dogs were tested at CQU (76.7%), and were female (70%), neutered (86.7%), mixed breeds (40%), and purchased from breeders or via dog shows (36.7%) as companion dogs (60%). The mean dog age was 5.6 years (±3.9yr) and mean weight was 20.4kg (±11.1kg). According to their guardians, 67% of dogs (two thirds) displayed moderate or severe fear during their veterinary visits. Approximately half of guardians (53.3%) took their dogs to the veterinarian once or twice per year. Additionally, twenty guardians (66.7%) report they most frequently took their dog to the vet in cases of emergency, or for annual vaccinations and check ups, while ten (33.3%) also conducted social visits to reinforce the dog for being in the clinic without a veterinary consult (guardians could select more than one option). A majority (83.3%) reported use of positive reinforcement training to help their dog cope better with veterinary visits, while 16.7% reported no training for that purpose. Over half of guardians (56.7%) report their dog had developed a fear of the veterinary clinic or examination over the time they had lived with the dog; the dog was not always fearful of the veterinary clinic.

Table 3: Demographics and experience of visiting a veterinary clinic in 30 privately owned, healthy dogs. Frequency is provided as a number (with percentage), unless otherwise stated as a mean (with standard deviation).

Demographic	**Number (%)**
Testing location	
CQU	23 (76.7%)
RW	7 (23.3%)
Sex	
Female	21 (70%)
Male	9 (30%)
Age (yr) Mean (±Std.Dev)	5.56yr (±3.94yr)
Neuter Status	
Neutered	26 (86.7%)
Entire	4 (13.3%)
Neuter Age Mean (±Std.Dev)	0.71 (±0.63yr)
Weight Mean (±Std.Dev)	20.44kg (±11.14kg)
Size	
Larger (>22kg)	19 (63.3%)
Smaller (<22kg)	11 (36.7%)
ANKC Breed Group	
Mixed breed	13 (43.3%)
Working	6 (20%)
Gundogs	5 (16.7%)
Hounds	3 (10%)
Utility	2 (6.7%)
Non-sporting	1 (3.3%)
Long term medications	
Not on medication	21 (70%)
Behavioural medication (e.g. generalised anxiety disorder, separation anxiety)	5 (16.7%)
Health medication (e.g. allergies)	4 (13.3%)

3.3.2. Physiological response to physical examination

3.3.2.1. Heart rate response from moving into consult room

The mean heart rate was significantly higher in the consult room (123.5 ±21.2bpm) in comparison to the waiting room (97.7 ± 19.6bpm; N= 29; $t(28) = -7.805$, $p < 0.001$). The mean percentage increase in dog heart rate from the waiting room baseline to average physical examination was 29.2% (min-max: -14.4% to 86.8%), while the mean maximum percentage increase from average waiting room to maximum physical examination heart rate was 82% (min-max: 17.3% to 150.6%).

3.3.2.2. Heart rate response within the consult room

In the consult room, heart rate peaked at 180bpm or above (an indication of sinus tachycardia (Hackett 2015) in 11 dogs at some point in the physical examination. An illustration of heart rate traces in a dog with a lower versus higher heart rate response can be seen in Figure 2. The maximum heart rate recorded was 230bpm (Dog 16, female, 4.4year old, ~25kg, greyhound), and the highest cumulative duration spent above 180bpm during the physical examination was 108 seconds (also Dog 16). An example of the interactions between heart rate and behavior during the Habituation, Stomach Palpation, Right Front Leg Check, Eye Check, Mock Vaccination phases five different dogs can be found in Supplementary Information: Figure 1.

Figure 2: Example of heart rate trace (bpm) of physical examination from Dog 17 (Greyhound, 4.5yr, female, 25kg; heart rate peaked above 180bpm) and Dog 35 (Border collie, 5.75yr, female, 22.2kg; heart rate remained below 180bpm), with 180bpm reference line in grey. Steps of physical examination are highlighted: A) Habituation; B) Right Front Leg; C) Right Back Leg; D) Left Ear; E) Mock Temperature; F) Mock Vaccination.

3.3.2.3. Factors that influence heart rate during a physical examination

The mean physical examination heart rate values for each variable of interest are displayed in Table 4. All factors were found to have a significant relationship with heart rate when analyzed in isolation (P <0.05), however when analyzed in conjunction with the random effect of 'DogID' (the individual dog), only sex and physical examination steps remained significant. Therefore, only these two factors are discussed in more detail. The autoregressive model included in the log likelihood ratio test suggests physical examination step order was not significant (p = 0.16). Therefore, while some physical examination steps independently influence heart rate, the preceding steps did not affect the physiological response of the current step (at least, in the order tested within this study).

Table 4: Demographic variables of interest for all dogs (N=30) comparing mean heart rate (bpm) for physical examination. Those highlighted in bold indicate significance at p <0.05

		Physical Examination Mean Heart rate (bpm ± std.dev)	**Wald test**
Demographic (n)		**Total physical examination (N=30)**	**p-value**
Sex	Female (21)	129.0 ±26.5	**0.015**
	Male (9)	110.0 ±21.2	
Size	Smaller (<22kg) (11)	133.1 ±26.0	0.106
	Larger (>22kg) (19)	117.1 ±25.0	
Guardian Treat	Yes (18)	118.0 ±24.3	0.211
	No (12)	130.6 ±27.8	
Examination Location	Floor (18)	115.0 ±24.2	0.372
	Table (12)	135.1 ±24.9	
TrainVet	R+ Training (25)	119.4 ±24.9	0.231
	No training (5)	140.4 ±26.6	

The mean heart rate responses to different stages of the physical examination differed significantly (p<0.001). The variation between steps is shown in Figure3, with letter grouping indicating significant differences between mean heart rate. The highest mean heart rates observed were in the Pats (137bpm ±25.2bpm), Right Front Leg (127.7bpm ±29.5bpm), Right Ear (127.5bpm ±27.2bpm) and Mock Vaccination (133.8bpm ±28.7bpm). The lowest mean heart rate observed was during the Teeth Examination check (109.6bpm ±23.6bpm). Of the 30 dogs included, thirteen failed at least one step of the examination due to behavioral escalation of fear (one dog failed five steps), and 28 failures were recorded in total. Of fifteen physical examination steps, only five (Pats, Chest Sounds, Palpation, Right Ear, and Mock Vaccination) were passed by all dogs. The physical examination step with the most failures was Teeth Examination (n=8), followed by Left Eye (n = 6) and Right Eye (n=5). The number of failures increased as the physical examination progressed, however there was no correlation between failures (in steps where there were failures) and heart rate group (X^2, Fisher's Exact, $p > 0.05$).

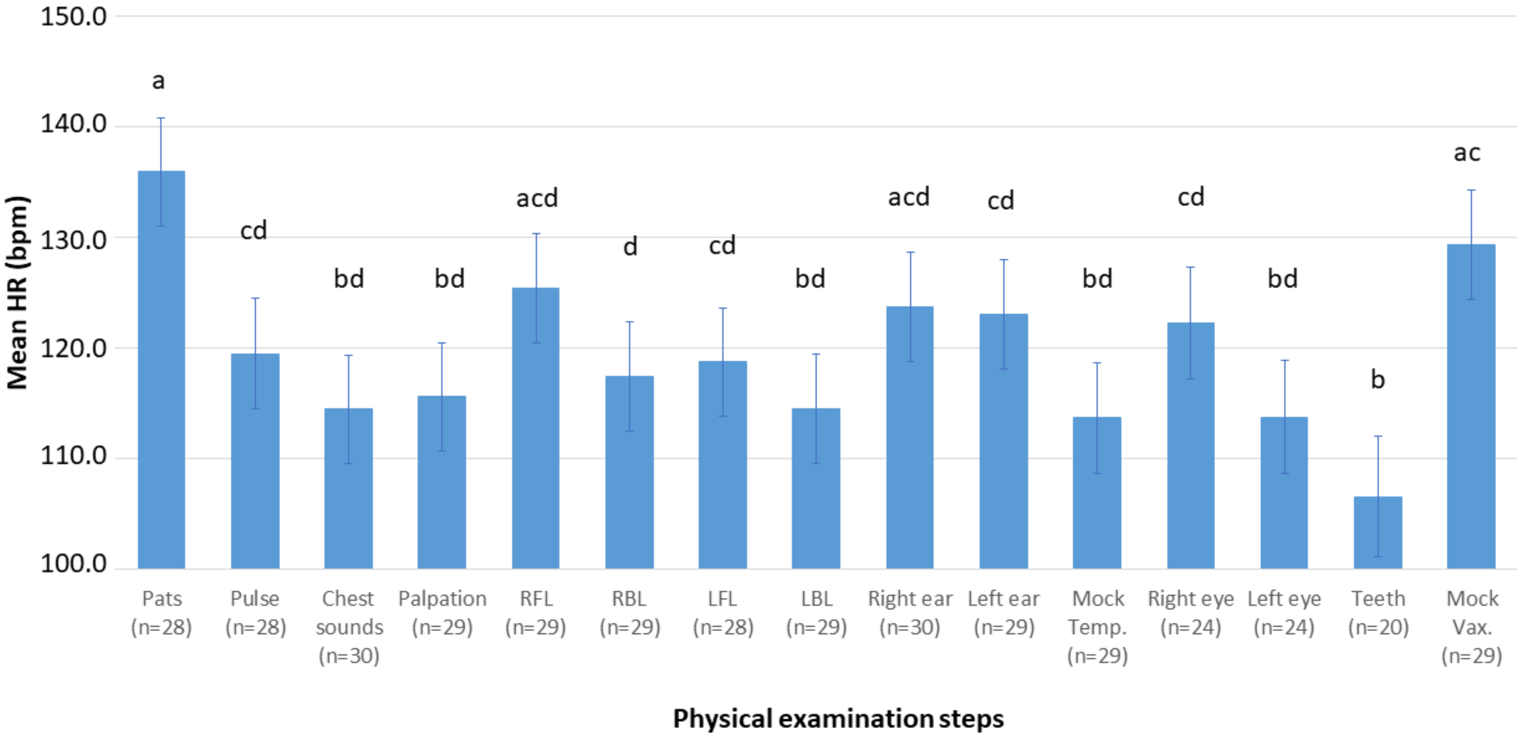


Figure 3: Mean heart rate (bpm ±standard deviation) for each step of the physical examination (predicted values include both sexes). Letters indicate significantly different grouping between mean heart rate for each step. Steps that share the same letter are not significantly different. For example: Pats has a significantly higher mean heart rate than Teeth Examination but is not significantly different to Right Front Leg.

3.3.3. Behavioral responses to physical examination

A Pearson correlation was conducted to identify the relationship between behavior and average physical examination heart rate. The average (mean or median) and min-max for each behavior can be found in Supplementary Information: Table 2. Average physical examination heart rate was correlated with the following duration behaviors: TailNeutral (r = -0.564, n = 29, p = 0.001); TailTuck (r = 0.392, n = 29, p = 0.032); EarsBack (r = 0.453, n = 29, p = 0.012); EarsNeutral (r = -0.381, n = 29, p = 0.038); MouthRelaxed (r = -0.417, n = 29, p = 0.022). For instance, there is a moderate positive correlation between the proportion of time a dog spent with its tail tucked and their increasing heart rate. Other duration behaviors (e.g., TailHigh, EarsForward, MouthClosed and Pant) were not significantly correlated with average physical examination heart rate.

3.4. Discussion

Gaining a greater understanding of how dogs experience their veterinary care better enables guardians, veterinary staff and researchers to tailor (and test) interventions to reduce or prevent stress developing over time. This study measured a dog's heart rate and behavioral responses to a standardized physical examination outside of the veterinary clinic environment. This is the first study of its kind to analyze continuous heart rate responses of dogs broken down by each step within the physical examination. We suggest that, even in a simulated veterinary setting, a physical examination is likely a stressful experience for some dogs, although the stressor within the examination may differ between dogs.

3.4.1. Heart Rate responses to the physical examination in the consult room

Average heart rate in the simulated consult room increased significantly from the baseline observed in the unfamiliar waiting room. This indicates that the standard physical examination itself elicits a heightened physiological response in healthy dogs, and not necessarily solely the veterinary clinic environment. Our results mirror those of Csoltova et al. (2017) who reported significantly higher heart rate during an examination in an unfamiliar room, in comparison to heart rate recorded pre- and post- examination in a neutral ‘waiting room’. Dogs also show more behavioral signs of fear when entering a consult room in a real veterinary clinic (Döring et al. 2009; Lind et al. 2017) and more physiological signs of stress within a clinic in comparison to home (Moesgaard et al. 2007; Marino et al. 2011; Soares et al. 2012; Bragg et al. 2015). However, dogs display increased urinary corticoid:creatinine ratios (a measure of adrenocortical function) relative to increasing invasiveness of care (for instance, hospitalisation versus a routine check-up with vaccination; Van Vonderen et al. (1998)). Therefore, the heart rate responses of healthy dogs observed in the present study could be even higher in a real veterinary clinic.

The mean heart rate (approximately 98bpm) observed at baseline in the waiting room is within the range of mean heart rate (approximately 84bpm-110bpm) in veterinary clinics recorded elsewhere (Ferasin et al. 2010; Marino et al. 2011; Bragg et al. 2015; Csoltova et al. 2017), while a range of 60bpm-120bpm is considered normal in dogs (Hackett 2015). However, while the mean heart rate within our consult room (approximately 123bpm) was close to this ‘normal’ range, one third of dogs had heart rate increases above 180bpm. While such high heart rate in dogs may be expected during physical activity, the dogs in the present study were at rest, and had been resting in the waiting room prior to the consult. Heart rate above 180bpm in dogs is a clinical sign of sinus tachycardia – a physiological response to pain, anxiety, hypoxemia, systemic inflammation or decreased blood volume (Hackett 2015). The maximum heart rate observed (230bpm) was also higher than those previously reported in clinical environments, and higher than the maximum heart rate recorded in retrospective ECG analysis of 243 dogs of 220bpm (Ferasin et al. 2010). These high heart rate recorded in the present study have implications for accuracy of diagnoses (Frank 2014), and cardiovascular health when considered in conjunction with other stressors dogs experience daily in an urban environment (Silva & Fontes 2019). They also foster concern for companion dog welfare. Mellor (2016) suggests good animal welfare is dependent on the net sum of good and bad experiences. As with humans (Baumeister et al. 2001; Storbeck & Clore 2008; LeBlanc et al. 2015), the arousal associated with a negative experience will greatly affect how a dog perceives their veterinary visit in the future (Döring et al. 2009).

In the present study, the examiner and researcher were very conscious of reducing the risk of behavioral escalation to aggression and the examiner was very experienced in practicing low stress handling techniques, which may reduce behavioral signs of stress (Scalia et al. 2017). Additionally, rectal temperatures are associated with an elevated heart rate in comparison to axillary or auricular temperatures (Gomart et al. 2014). A Mock Rectal Temperature was taken here, and it is likely the low stress handling approach and Mock Temperature in the simulated veterinary setting reduced the severity of the dog's heart rate response to the physical examination. As such, we emphasize the responses observed in the present study are likely to be more extreme in a real veterinary context, depending on the handling techniques used.

3.4.3. Individual variation in response to physical examinations

A standardized physical examination in healthy companion dogs elicits a significant variation in heart rate responses. The Pats and Mock Vaccination had the highest mean heart rate observed. While high heart rate during Pats may reflect a positive affective state, it is important to note the type of interaction and level of familiarity of the handler play a significant part in physiological and behavioral responses to petting (Kuhne et al. 2012, 2014a, 2014b). Here, the examiner was unfamiliar and interacting with the dog in a standardized, neutral way. It is impossible to be sure if increasing heart rate during Pats was associated with a negative or positive state, although throughout the physical examination increasing heart rate was moderately, positively correlated with some potential behavioral signs of fear. The high heart rate for Mock Vaccination may result from specific context cues (pinch withers and inject with other hand) that are consistently associated with the needle during a real vaccination, as dogs can learn to anticipate pain (Overall 2013). In contrast, an unexpected outcome of the present study was the discrepancy in the Teeth check having the lowest observed average heart rate, and highest failure rate, although failure rates and heart rate group (above or below 180bpm) were not significantly associated. Dogs that showed signs of behavioral escalation to aggression, or that struggled to the extent that the examiner would have requested an additional staff member to assist, were coded as 'fails' for that step. As such, this discrepancy may be because 'failures' during a teeth check were more from struggling behaviors (e.g., wriggling their head) than fear-based behaviors (e.g., tail tucked/ ears back). As such, future research warrants clarification for different reasons for failure (e.g., behavioral escalation of fear or aggression versus excessive struggling).

There was no significant effect with respect to order of steps within the physical examination. A dog's heart rate response did not increase overall as the examination progressed, but was isolated to each step (at least, within the order and process conducted here). This mirrors the findings of Csoltova et al. (2017) that testing order (first or second visit) did not influence behavioral or physiological responses. Generally, dogs respond differently to different fear-inducing stimuli (Beerda et al. 1998). Wormald et al. (2017) highlight a difference in ability to cope based on individual variation in heart rate variability parameters, dependent on the presence or absence of anxiety-related behaviors on a guardian reported behavioral scale. The variation observed in physiological responses to different physical examination steps in the present study suggests there is no one aspect of an examination that is the catalyst of fear for dogs; fear of the veterinarian likely develops for each dog differently, and can occur independently of the veterinary clinic setting.

In addition to this, a dog's heart rate response to the physical examination was influenced by their sex. On average, female dogs had higher heart rate than male dogs. Similarly, although based on behavioral observations, Döring et al. (2009) report male dogs were significantly less fearful than female dogs. No weight or size effects were identified in the present study. Although smaller dogs have previously been reported to have a slightly higher heart rate reference range than larger dogs (70bpm – 120bpm in comparison to 60bpm-120bpm respectively; Hackett 2015). Ferasin et al. (2010) suggest demeanour at baseline (e.g., calm, excited or nervous) and age are stronger contributors to heart rate in dogs than sex or size from a retrospective ECG analysis (n=243) and a prospective clinical examination (n=153). Indeed, Edwards et al. (2019a) suggest the effect size for the demographic contribution (e.g., breed, size, source) toward variation of fear reported by guardians in a veterinary context is relatively low (approximately 7%), and as such it is likely other factors such as the clinic environment or dog's previous history (e.g., human-animal interactions or the clinic environment) are much larger contributors. While demographics may provide some insight into the severity of a dog's response in a veterinary clinic, we suggest future research should focus on how the veterinary environment, or provision of care (e.g., how the physical examination is conducted) influence welfare in the veterinary context.

In the present study, training to assist in coping more positively within the veterinary context did not have a significant effect on the heart rate responses observed. Stellato et al (2019b) report potential benefits in a structured 4-week desensitisation and counter conditioning programme using positive reinforcement in helping dogs fearful of veterinary visits become more comfortable with handling. The use of training for cooperative care practices (e.g., teaching a dog to remain still for aspects of an examination) are also reinforced in Howell & Feyrecilde (2018) and Jones (2018). In contrast, Stellato et al. 2021 found training with the use of positive punishment (the application of aversive after an unwanted behavior) generally, and within the clinic specifically, increased the likelihood a dog would be reported as aggressive within a veterinary context by their guardians. Examination location and whether the guardian fed treats were not significantly associated with heart rate or behavioral signs of fear in the present study. Döring et al. (2009) identified dogs examined on the table showed more behavioral signs of fear than those examined on the floor, and the use of food as a counter-conditioning aid is recommended (Overall, 2013; Westlund, 2015; Howell & Feyrecilde, 2018; Jones, 2018). Perhaps in the present study, the sample size was not large enough to see an effect. It is also possible the training approach undertaken by guardians was not structured or consistent enough, or food treats provided at the correct contiguous or contingent intervals. These points of difference offer valuable avenues for future research.

3.4.4. Behavioral signs of fear were correlated with heart rate

Some behaviors indicative of fear (e.g., tail tucked, ears back) were positively moderately correlated with increasing heart rate, while the proportion of time spent with a relaxed mouth was associated with decreasing heart rate. Stellato et al. (2019a) report posture reduction behaviors (e.g., presence/absence of ears back or tail tucked) were influenced by phase of examination (e.g., head examination or body Palpation). However, the authors did not report a correlation between physiological and behavioral responses, due to each physiological parameter only being collected once at the relevant stage during the procedure, whereas behavioral data was collected throughout. Shaking, liplicking, paw lifts, changes in posture (e.g., sitting, standing), yawning and overall posture have been previously associated with physiological signs of stress in dogs outside of the veterinary context (Beerda et al. 1996; 1997; 1998; 2000). Studies investigating a stress reduction intervention within a veterinary clinic compare the frequency or presence of fear-related behavior between groups (Döring et al. 2009; Csoltova et al. 2017; Scalia et al. 2017; Stellato et al. 2019a; Hauser et al. 2020), yet those behaviors were not correlated with a physiological measure within the study. As fear-related behaviors (e.g., tail tuck or ears back) have been previously used to infer a dog's affective state, we emphasize that dogs undergoing a standardized physical examination show an increase in both behavioral and physiological signs of fear.

The use of behavioral parameters as indicators of welfare in companion animals are not yet well established in the peer reviewed literature relative to production animals (Hiby et al.2006). Some behaviors used to measure stress in dogs may not only occur in stressful situations (Beerda et al. 2000) and animals have an inherent individual coping style that interacts with environmental demands to influence health and welfare (Koolhaas et al. 1999). Similarly, individual variation in physiological and behavioral responses in dogs are highlighted within the veterinary context (Van Vonderen et al. 1998; Csoltova et al. 2017). In addition to this, some behavioral responses can become learned responses (Rooney et al. 2007; Overall 2013), being selected for, or against, in human interactions (consciously or not) through consequence-based operant conditioning processes (Thorndike 1927; Skinner 1965; Chance 2009). For instance, guardians may reinforce lip licks because they look like 'kisses', or punish a dog for growling. In essence, a process of behavioral micro-evolution. Dogs can also learn to escalate to aggression quickly if earlier, more subtle warning signs are missed (Moffat 2008; Shepherd 2009; Overall 2013). As such, the value of behaviors as a non-invasive welfare parameter in companion dogs is used to best effect in conjunction with physiological measures of stress.

3.4.5. Implications for guardians and the veterinary industry

The findings of the present study suggest a routine aspect of veterinary care, the physical examination, elicits a fear response in healthy companion dogs in a mock veterinary setting. This means that while fear may develop relating to other animals present, sounds or odours, there may also be parts of the physical examination that provoke fear either because of a previous negative experience relating to a physical examination, or fear relating to handling. Further, a majority of guardians (70%) reported they felt as though their dog's reaction to their veterinary care was either remaining the same or getting worse over time. Döring et al. (2009) report dogs displayed more behavioral signs of fear in the current (neutral or positive) visit, if their guardian reported the previous visit was a negative one. This highlights a very real concern for continual aversive experiences in the absence of any management-based, pharmaceutical or training intervention. As Sherman and Mills (2008) suggest in the clinical treatment of separation anxiety and noise reactivity in dogs, we emphasize the value of a two pronged approach in working with dogs fearful of their veterinary care: 1) Immediate short-term, management for relief in critical care situations (e.g., pharmaceutical sedation or anxiolytics) and adaptations to clinic environment if one aspect stands out as the overwhelming stressor (e.g., treatment outside/ non-slip surfaces), and; 2) clinician and guardian investment in a long-term solution addressing the underlying causes of fear of veterinary care. Edwards et al. (2019b) provide a summary of strategies to reduce fear in dogs in the veterinary context from multiple stakeholder perspectives, while Riemer et al. (2021) review strategies to ameliorate fear across aspects of a veterinary visit in dogs and cats. Comfort, pleasure, interest, confidence and a sense of control are highlighted as facilitators of positive experiences in captive animals (Mellor 2016). Indeed, having control over outcomes influences positive emotional state (McGowan et al. 2014), and predictable stressors reduce physiological stress responses in dogs compared to unpredictable stressors (Beerda et al. 1998).

In light of the results of the present study, we suggest dogs and their guardians, and veterinary staff, may also benefit from long-term approaches to the *prevention* of fear relating to physical examination in the veterinary clinic as a priority. One consideration for veterinary practice is the order of events a physical examination should occur in. While there are many theories pertaining to memory, trauma, fear and learning, Kahneman et al.'s Peak-End Rule (1993) suggests the most emotionally intense and the last aspect of an experience are easiest to remember. Although more research is required to support our findings, this may mean that the vaccination (having the highest heart rate) should not be the final aspect of an examination, but rather a less invasive or intense step. Alternatively, veterinarians can ensure the last aspect of an examination is a pleasant experience – perhaps several high value food rewards or a chance to play with a toy. The strategies that may reduce stress highlighted by Edwards et al. (2019b) and Riemer et a. (2021) may also be feasible to use in its prevention and offer critical areas for future investigation.

3.4.6. Limitations and future research

This research was conducted with a small convenience sample of companion dogs in order to explore the individual reactions to different aspects of a standardized physical examination outside of the veterinary clinic. While the sample size is consistent with other studies on companion dog welfare (Hiby et al. 2006; Csoltova et al. 2017; Stellato et al. 2019a), this provided several limitations, and a larger sample size may have increased the statistical power available to us and reduced the inherent variability observed in the random effect of DogID. This is especially the case in restricting the ability to compare behavioral and heart rate responses within each step of the physical examination, while also accounting for the repeated measures aspect and other demographic variables of interest. In the present study, guardian reported fear during veterinary visits, the use of medication for behavioral diagnoses (e.g., anxiety) and guardian routines regarding veterinary visits (e.g., frequency of visits, reasons for visits) were not analyzed in relation to heart rate due to the limited sample size. While every effort was made to reduce stress while fitting the heart rate strap to the dogs pre-examination, the presence of the strap and a relatively short window of habituation may have been a confounding stressor in the heart rate data observed. However, the strap was flexible and of a conforming material, appeared very similar in nature to a harness on the dog, and as the heart rate was also recorded during the waiting phase any discrepancies in recorded heart rate would be consistent.

We acknowledge the discrepancy between simulation (e.g., Mock Vaccination) and reality, and anticipate the behavioral and physiological responses from dogs would be greater during those steps in a ‘real’ physical examination within a ‘real’ veterinary clinic. Although activity of the dogs immediately prior to participating in the study was not assessed, dogs were at rest within the waiting room and consult room and exercise immediately before a normal veterinary consult may reflect a natural order of events regardless. Likewise, entering an unfamiliar room may also have had an effect on a dog’s stress response, but is also often an unavoidable aspect of a dog’s veterinary experience. Further, approximately one third of participants reported conducting social visits to the veterinary clinic for their dog, and 83.3% reported training their dogs to cope better with a veterinary visit. As such, the sample may reflect recruitment bias toward guardians who are more invested in helping their dog cope at veterinary visits, and/or who have recognized their dog becomes stressed in the clinic. However, these frequencies are unreported in Australia in the peer-reviewed literature, and so this may be reflective of the general population as fear free veterinary care gains traction (Demaline 2018). Similarly, the extent to which the sample is biased toward dogs that are more or less fearful (depending on whether these social visits or training for cooperative care are effective strategies to reduce stress) during veterinary visits is unknown. Heart rate (bpm) was used in the present study as a reliable, relatively non-invasive physiological measure that provides immediate feedback on the dog’s response (Beerda et al. 2000) to the different stages of physical examination.

Heart rate only measures physiological arousal and not positive or negative state, although the fear-related behavioral responses correlated with increasing heart rate and suggest that the increase in heart rate was at least sometimes negative in nature. However, only some behavioral signs of fear were correlated with heart rate, and heart rate and behavior could not be assessed within each step of the physical examination. As such, the results reported here should be interpreted with caution and more research is required. The varying duration of the physical examination for each dog was not included in the statistical model as the preliminary analysis suggested there was no significant correlation with heart rate and the model controlled for the different steps of the physical examination which also varied in length for each dog. However, future research investigating the effects of different stages of the physical examination may require a larger sample size, randomized order of steps or consistent times for each step to complement the outcomes of the present study. The inclusion of heart rate variability, or other physiological measure (e.g., salivary cortisol) would be a valuable additional measure informing companion dog welfare in a veterinary setting.

3.5. Conclusion

The findings reported in this study demonstrate that heart rate may be significantly elevated in some dogs during a routine physical examination, with behavioral signs suggestive of negative stress. The simulated examination we used was conducted outside of a standard veterinary environment (which includes sights, sounds, smells or slippery surfaces). This suggests that there are aspects of the physical examination alone that lead to increases in heart rate, but also that the reactions from the dogs reported here are likely underestimated. Importantly, we have demonstrated individual variation in heart rate and behavioral responses to different aspects of a veterinary examination; suggesting a dog's veterinary experience is unique to them, and is influenced by their individual veterinary history and perception of the current environment (including interactions with veterinary staff and their guardians). Veterinary staff and guardians must take every reasonable step to reduce or prevent a fearful experience during veterinary visits.

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3.7. Ethical statement

Guardians were informed about the general aims and testing procedures of the study prior to participating and provided written consent before participation. This research was approved by the University of Adelaide Human Research Ethics Committee (approval number: H-2019-014), and the Animal Ethics Committee (approval number: S-2018-093) and conformed to national guidelines regarding use of animals in research.

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3.9. Chapter 3: Supplementary Information

3.9.1. Supplementary Information: PERL Coding

PERL Coding to parse state and duration behaviours:

This file documents the process used to parse the raw data to create correlated and consolidated csv files.

The primary purpose of the scripts used is to produce two spreadsheets containing consolidated data from the raw data collected. In the process, numerous intermediate files are generated in each dog folder including a "correlated.csv" file for the individual dog.

The process uses "perl" and shell scripts because these tools are efficient and proven for general text processing. They should work on any system that contains a POSIX environment including a "bourne shell (/bin/sh)" and Perl 5. They will work on almost any unix style system.

Terminology:

- "state" means behaviours that have "durations".
- "freq" means behaviours that have "counts".
- "section" means the overall grouping of behaviours, either "body" or "head".
- "set" means the group of behaviours for each "section".
- "class" means the grouping of triggers, either "PhysicalExam" or "NailClip".
- "exclusive list" is the list of "state" behaviours where only one is permitted at any time.
- "debug" means information output from scripts showing detailed information about the processing.
- "ERROR" means an error was found in the raw data.
- "WARN" means an anomaly was found in the raw data .
- "Correlated" means behaviour data correlated with trigger data.
- "Consolidated" means correlated data from all dogs consolidated into single tables.

The process went:

- Read Dog##.Head*.csv through remove_duplicates.pl to produce dog##-head_cleaned_freq.csv and dog##-head_cleaned_state.csv

- Read Dog##.Body*.csv through remove_duplicates.pl to produce dog##-body_cleaned_freq.csv and dog##-body_cleaned_state.csv

- Read dog##-*-cleaned_state.csv (body and head intermediate files) through parse_state.pl to produce dog##-state_unsorted.csv

- Read dog##-state_unsorted.csv through unix "sort -n" (sort numerically) to produce dog##-state_sorted.csv

- Read dog##-*-cleaned_freq.csv (body and head files) through unix "sort -n" to produce dog##-freq_unsorted.csv

- Read Dog##.TriggerTimes.csv through parse_triggers.pl to produce dog##-triggers.csv

- Read dog##-triggers and dog##-state_sorted.csv through calc_OOS.pl to produce dog##-OOS_freq.csv and dog##-OOS_state.csv

- Read dog##-triggers.csv, dog##-freq_sorted.csv and dog##-OOS_freq.csv through correlate_freq.pl to produce dog##-correlated_freq.csv

- Read dog##-triggers.csv, dog##-state_sorted.csv and dog##-OOS_state.csv through correlate_state.pl to produce dog##-correlated_state.csv

Rinse and repeat for each dog and then:

- Run consolidate_by_trigger_and_dog.pl to produce all_[freq|state]_by_trigger.csv

- Run consolidate_by_dog.pl to produce all_[freq|state]_by_dog.csv

- Run consolidate_by_trigger.pl to produce the pass/fail summary all_triggers_pf.csv

The "root" folder contains the following files used by the scripts:

- A file "state_exclusive_list.csv" holds the state section/set exclusive lists

- A file "behaviourlist.csv" the frequency behaviours to "sections"

- A file "trigger_list.csv" holds the complete list of triggers including gaps

- A file "trigger_class.csv" maps the class to each trigger

- A file "process_dogs.sh.debug" holds the debug output from the last run of script process_dogs.sh

- A file "errors_from_debug.txt" contains ERRORS and WARN lines "grepped" from all the debug output.

- A file "cross_check_freq.sh.txt" contains the output from a cross check of a frequency behaviours

- A file "cross_check_state.sh.txt" contains the output from a cross check of state behaviours

Folders starting "Dog##" contain the original raw data and the processed data.

In each of these:

- Files starting "Dog" are the raw data.

- Files starting with "dog" are the processed data.

- Files ending in "debug" are the debug output from the scripts.

The folder "heart_rate" holds the raw heart rate file and the consolidated heart rate csv

The folder "consolidated_by_trigger" contains the two resulting csv files: "all_consolidated_freq.csv" and "all_consolidated_state.csv" and consolidated csv files for each individual trigger.

The "bin" folder holds all of the scripts used as follows:

** check_trigger_times.pl

- Checks that the trigger times are consistent

** remove_duplicates.pl

- Takes the raw files in a "Dog" folder, removes duplicates and adds
  "section and set info for the state data and "section" info for freq

- This produces 4 intermediate files like:
  "dog##-[body or head]_cleaned_[freq or state].csv"

** parse_freq_triggers.pl

- Takes the raw trigger file and adds "gap" triggers along with durations

- Creates a new trigger file dog##-triggers.csv

** parse_state.pl

- Takes the state "cleaned" files output from remove_duplicates and

- the triggers file from parse_freq_triggers.pl and figures out

  duration of the behaviours including OOS etc

- Produces a file dog##-state_unsorted.csv with combined head

  and body data. This is then sorted into dog##-state_sorted.csv

** correlate_freq.pl

- Takes the trigger data and the sorted cleaned frequency files

  and correlates both into the dog##-correlated_freq.csv file

** correlate_state.pl

- Takes the trigger data and the sorted cleaned state data

  and correlates both into the dog##-correlated_state.csv file

** consolidate_by_trigger_and_dog.pl

- Consolidates the data for all the dogs by trigger into files

  in the consolidate_by_trigger folder

** consolidate_by_trigger.pl

- Consolidates the pass/fail status for all the dogs by trigger

** process_dog.sh

- Runs all the above scripts against the raw data in a "Dog" folder

** process_dogs.sh

- Runs process_dog.sh against each "Dog" folder in turn

- Then it runs consolidate_by_trigger.pl which produces the consolidated

- output in the folder "consolidated_by_trigger".

** check_for_errors.pl

- Checks "debug" files for a couple of error states.

- The only errors currently showing is for the overlapping trigger LFLTreat in Dog29

** clean_dog.sh

- Cleans a "Dog" folder of all intermediate and debug files

** consolidate_heart_rate.pl

- Takes the raw heart rate data and produces a consolidated sheet in
  the heart rate folder "all_dogs_heart rate.csv"

Ignore the check_[freq|state].[pl|sh] scripts, they were just used for quick and dirty sanity checks.

Most of the scripts have further information at the top.

Each script produces a debug file (script-name.debug) in each Dog folder documenting how the data was processed.

The script process_dog.sh shows how each of these scripts are used and in which order.

Two cross check scripts were used to validate the outputs.

** cross_check_state.pl - Takes parameters: Dog## section set

This produces durations of states for a particular section and set using a "state machine" instead of control-break methods. It selects states entries from raw data and records the "state" present for for each second from 0 to the END timestamp in the trigger file. The output is the total number of full seconds that each behaviour was found. This can be manually checked against the correlated output _totals_. It is unlikely to match the totals exactly as the correlated output uses exact times not full seconds.

** cross_check_freq.pl - Requires paramaters: Dog## behaviour

This checks the raw data, the intermediate file "-freq_sorted.csv" and the correlated file from a dog folder for a specific behaviour and outputs totals for the behaviour for each of them. The output can be checked to see if the totals match for each method used. It also outputs the totals for that behaviour for all dogs.

** cross_check_freq.sh - Requires parameters: behaviour

This runs cross_check_freq.pl against every dog for a behaviour and outputs the results.

** cross_check_state.sh - Requires parameters: section set

This runs cross_check_state_pl against every dog calculating durations of behaviours in a section and set

3.9.2. Supplementary Information Table 1: Methods

Complete behavioural ethogram with definitions observed during physical examination. Frequency behaviours were grouped into categories (e.g. Avoidance). Behaviours scored as either state (S) or frequency (F) with head (H) or body (B) focus.

Behaviour	Measure	Focus	Description
Avoidance behaviours			
Struggle	F	B	Attempts to escape being held or restrained, resists being held
Change	F	B	Voluntary movement from a sit to stand or drop and vice versa, including intentions to change that are interrupted by examiner or guardian (e.g. a dog that tries to sit during a Fake Temperature check is kept standing by examiner).
MoveAway*	F	B	Facing examiner or owner before moving away 1-3 steps toward nothing (e.g. not distracted by movement in room). Looks like pacing/ fidget behaviour
Escape	F	B	An attempt to escape the room, jump from the table, or pull back forcefully on the lead/ refusal to interact
Posture reduction			
Cower	F	B	Crouching, cowering/ overall lowering of body posture
ShowStomach	F	B	Inguinal display, lying on back/ side with front leg up and back leg splayed to expose belly
HeadDuck	F	H	Head at lower than normal (breed standard) carriage
Displacement behaviours			
LipLick	F	H	Tongue flick, nose lick, lip lick
HeadTurn	F	H	Avoiding eye contact or looking at the stimulus; turns head away from owner or examiner
Yawn	F	H	Mouth open wide for a period of a few seconds then closes, including intention to yawn
Blink	F	H	Dog's eyes close and open (blink), may half close
GazeOwner	F	H	Dog moves head to look at owner's face/ torso. Gaze can be any duration.
GazeExaminer	F	H	Dog moves head to look at examiner's face/torso. Gaze can be any duration.
Sniff	F	H	Head to floor as if to sniff, no new scent; sudden short sniffing of ground, including intention to sniff
Scratch	F	B	Back leg scratches flank/ neck

PawLift	F	B	Lifts one forepaw off the ground and rests weight on remaining forepaw, sustained for several seconds when stationary
Vocalise behaviours			
Vocalise	F	H	Yelp, whine, whimper, sneeze (5s elapsed between sounds to count as event)
Snarl	F	H	Lift lip, show teeth, growl, snap
Miscellaneous behaviours			
Watch	F	H	Dog turns head 45 degrees or more toward examiner's hands while being handled/ examined (e.g. as if to watch what the examiner is doing)*Differs from GazeExaminer as dog is not watching the Examiner's face or torso
Startle	F	B	A tense small jump (or 'muscle spasm') in response to a stimulus (perceived by human) in the environment (e.g. startle response to touch, or to something being dropped).
Reset*	F	B	Owner or examiner physically move dog back into the examination zone (middle of table or mat), examiner moves dog into position needed for exam (e.g. lifts dog into a stand to check temp).
ShakeOff	F	B	
Jump	F	B	Jumps up on/ against owner

3.9.3. Supplementary Information Figure 1:

Example of the heart rate and behaviour for the Habituation, Stomach Palpation, Right Front Leg check, Eye Check and Mock Vaccination phases of the physical examination, in five different dogs.

Youtube link (Unlisted): https://youtu.be/9FoxphuLpRg

3.9.4. Supplementary Information Table 2: Results

Pearson Correlation with Average heart rate for the entire physical examination. Behaviours are reported as frequency per minute or percentage time in sight.

	Total physical examination		**Pearson Correlation with heart rate**
Behaviour	**Median**	**Min-Max**	**p-value (r)**
Grouped frequency behaviours (frequency per minute)			
Displacement[1]	11.33 ±4.70	3.61-22.82	0.825 (0.042)
Avoidance	1.71	0.10-4.89	0.439 (0.147)
Posture reduction	0.24	0.00-1.810	0.331 (0.184)
Vocalisation	0.00	0.00-1.22	0.794 (0.050)
Miscellaneous	1.42	0.34-5.53	0.833 (0.040)
Individual frequency behaviours (frequency per minute)			
Struggle[1]	0.90 ±0.56	0.00-2.29	0.982 (0.004)
Change[1]	0.66 ±0.50	0.00-1.68	0.911 (-0.021)
LipLick[1]	4.05 ±2.23	0.98-9.01	0.792 (-0.050)
GazeOwner[1]	1.25 ±0.81	0.12-3.19	0.271 (-0.208)
Blink	2.97	0.61-13.06	0.393 (0.162)
Watch	1.08	0.19-4.17	0.756 (-0.059)
GazeExaminer	1.01	0.24-2.66	0.641 (-0.089)

[1]Normally distributed, mean ± std. deviation

Chapter 4

Puppy pedicures: exploring the experiences of Australian dogs to nail trims

Introduction

Following the findings of Chapter 2 and to build on the outcomes of Chapter 3, this Chapter investigates a dog's physiological and behavioural responses during another routine aspect of veterinary care – nail trims. Immediately following the physical examination described in Chapter 3, the same 35 dogs underwent a standardised nail trim procedure, with heart rate (bpm) and behavioural responses recorded. Chapter 4 offers a novel contribution to the literature in companion animal welfare generally as peer-reviewed evidence on nail trims or grooming in companion dogs is remarkably scarce.

Statement of Authorship

Title of Paper	Puppy pedicures: exploring the experiences of Australian dogs to nail trims
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☑ Unpublished and Unsubmitted work written in manuscript style
Publication Details	The following manuscript is ready to be submitted to *Journal of Applied Animal Behaviour Science*, immediately after receiving confirmation that Chapter 3 is in press. Due to the shared nature of this research, I have decided to wait for the decision on Chapter 3 to be able to refer to the methods in publishing Chapter 4.

Principal Author

Name of Principal Author (Candidate)	Ms. Petra Edwards		
Contribution to the Paper	Conception Acquiring Data Knowledge/ Methodology Analysis Drafting Reviewing & Editing		
Overall percentage (%)	70%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	29/11/2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Dr Susan Hazel
Contribution to the Paper	15% Conception Knowledge/ Methodology Analysis Drafting Reviewing & Editing

Signature		Date	30/11/21

Name of Co-Author	Dr Bradley Smith		
Contribution to the Paper	10% Acquiring Data Analysis Drafting Reviewing & Editing		
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Name of Co-Author	Associate Professor Michelle McArthur		
Contribution to the Paper	5% Analysis Drafting Reviewing & Editing		
Signature		Date	3/12/21

Abstract

Appropriate nail care is an important aspect of companion dog health and welfare. Nail trims can be painful for dogs if not done correctly, yet little is known about how dogs experience the procedure, nor the perceptions of guardians relating to nail maintenance. The present study aimed to investigate the physiological and behavioural responses of 35 companion dogs (of various age, breed and sex) to a standard nail trim procedure in a mock veterinary setting, as well as how their guardians approach nail maintenance. Physiological responses were measured via continuous heart rate (bpm) from a Polar® H10 strap and M430 watch, and behaviour was video recorded and coded retrospectively. Heart rate during the nail trim was significantly higher (121.7 ±18.3bpm) than the baseline heart rate (97.3 ±19.0bpm; N=34; t (33) = -8.224, p=0.001). Factors that predict mean heart rate response were analysed with a multiple linear regression model, and dog sex and sum of stress behaviours (e.g. proportion of time spent with ears back, tail tucked and panting) were found to be significant. These factors explained 56.8% of the total variation of heart rate observed; $F(5, 27) = 7.11$, $p < 0.001$, $R^2 = 0.568$. Nearly half (45.7%) of dogs struggled excessively or escalated to aggression during clipping of at least one nail during the procedure. It is likely that the physiological and behavioural responses observed by dogs within this study may be more extreme in a real veterinary clinic (which itself often evokes fear responses in dogs). Considerable variation in relation to how guardians approach nail maintenance was found. Approximately one third of guardians reported their dog required nail trims two to five times per year, and just under one third of dogs never needed trims. Nearly one in three (31.4%) dogs had experienced a painful trim in the past. Guardians sought assistance with nail trims from a variety of sources (including veterinary practices and groomers) but also trimmed the nails themselves. This initial exploration into nail trims suggests they may be stressful for companion dogs, and highlights the valuable avenues for further investigation for how nail trims may be impacting companion dog welfare.

4.1. Introduction

Nail trims for companion dogs are an important aspect of companion dog welfare (see Seymour and van der Heiden, 2009; Lumbis, 2007) and are a service provided by general practice veterinary clinics and groomers alike. However, with some exceptions (e.g. Landau et al., 2016), remarkably little peer-reviewed evidence exists relating to how dogs experience nail trims, or routines relating to nail maintenance. For example, there is no consensus on the required or recommended frequency for trims, a standardised, tested procedure, knowledge about who trims the dog's nails (e.g. vets or guardians) and how nail care might change as dogs develop. Further, many dogs are fearful of their veterinary visits and struggle with aspects of the physical examination (Csoltova et al. 2017; Stellato et al. 2020). The base of the claw contains the dermis (colloquially known as the 'quick'), which contains the blood capillaries and nerve fibres (Aspinell & Cappello 2009). The quick is painful if cut, adding to the potential risk of negative experiences for companion dogs in the veterinary clinic and other handling experiences. Anecdotally, dogs dislike having their nails trimmed, although the extent to which this is due to the trim itself, or another aspect of handling or restraint, or how such fears may impact fear in the veterinary context warrants further research. Research into how companion dogs experience their nail trims, and the guardian routines around nail maintenance, can provide valuable insight into the welfare implications for this standard aspect of companion dog care.

Indeed, approaches to nail trim procedures vary greatly. Recommendations for the procedure range from those found in veterinary nursing textbooks (e.g. Seymour and van der Heiden, 2009), to suggestions made by any member of the public on social media platforms. Some online recommendations for nail care information or strategies to complete a nail trim stem can be found via membership to welfare-centric, proactive and positive reinforcement based cooperative care and nail maintenance Facebook™ groups (e.g. 'Nail Maintenance for Dogs', or 'Cooperative Veterinary Care') or short online courses (e.g. 'Nailed It!' by Lori Nanan). Other recommendations are less welfare-centric and more task-oriented, and involve extreme physical restraint (e.g. grooming slings) without addressing the underlying fear or distress of the nail trim experience, and others still are simply plain odd or dangerous (e.g. smearing peanut butter on your forehead while trimming your fearful dog's nails - putting your face at risk while unable to watch for behavioural escalation to aggression). Identifying the sources of information guardians use for nail maintenance advice, and assessing various recommended procedures for efficacy and optimal dog welfare and guardian safety as priorities, would be an invaluable addition to this field of research in caring for companion dogs.

Acclimating companion dogs to required husbandry procedures and grooming practice (e.g. nail care and handling) is a valuable component of companion dog training and care (Mills, 2009; Howell & Feyrecilde 2018; Morris, Grandin & Irlbeck 2011; Overall 2013). Indeed, husbandry and handling are critical aspects of good welfare in working dogs (Rooney, Clark & Casey 2016), dogs in commercial breeding facilities (Stella et al. 2018), and animals used in research (Prescott et al. 2004). Yet, one of the reported challenges of dog ownership reported by the millions of Australians who live with dogs, is grooming (Animal Medicines Australia 2019). Ongoing cost and responsibility are listed as downsides to caring for a companion animal. Nail maintenance can be incorporated into grooming services, and the investment in such services may become a barrier to dog welfare. Evidence for the extent to which nail maintenance may be a barrier to dog ownership or companion dog welfare is lacking.

Little is known about nail growth for companion dogs and how nails wear over time. Seymour and van der Heiden (2009) suggest potential causes of overgrown nails can include: sole exercise on soft ground (e.g. grass); housing and management restrictions; elderly animals (or those unable to exercise due to fractured or immobile limbs); injuries or disease conditions of the foot or nail; previous injury to the leg causing an abnormal gait that impacts natural wear of the nail; puppies in the nest; and animals causing damage to property (namely in response to cats). Zink and Schlehr (2020) emphasise the difference in morphology of dog breeds from an ethological and artificial selection perspective; dogs selectively bred for various domesticated working roles need to have bodies that allow them to perform that role safely and efficiently. Gaining a greater understanding of nail growth rates, appropriate nail length, the benefits of exercise on specific surfaces to inform nail maintenance processes, or how inappropriate nail length may impact gait or physical structure, are valuable avenues for future research.

Dogs may also be prone to nail injuries, although little is known about the prevalence and severity of cases in companion dogs in Australia. Of 3,670 dogs taken to a veterinary hospital in Bangladesh (India), 0.19% presented with an injury to the nail (Tarafder & Samad 2010). In a sample of United States military working dogs deployed to Iraq between 2003 and 2007, 29 of 796 (3.6%) were recorded to have a nail related injury (Mey 2009). Injuries to the toes (phallanges) and forelimbs are commonly reported in dogs training for, and competing in, competitive sports like agility, flyball and canicross (Cullen et al. 2013; Lafuente & Whyle 2018; Sellon et al. 2018). However, the extent to which overgrown nails or nail health may impact the likelihood of such injuries in other aspects of companion dog life is not established.

The present study aimed to improve our current understanding of nail trims in companion dogs by exploring a convenience sample of 35 dogs and their physiological and behavioural responses to a nail trim procedure. A survey of the dog's guardians was also conducted in order to gain insight into their approaches to, and experiences with, nail maintenance.

4.2. Methods

4.2.1. Participants

Participants were recruited as part of a broader study investigating the heart rate and behavioural responses of companion dogs to a standardised physical examination in a mock veterinary clinic setting. Recruitment occurred via social media (dog training clubs, dog support groups, The University of Adelaide based social groups), and poster advertisements at The University of Adelaide School of Animal and Veterinary Sciences and local veterinary clinics. A total of 35 guardians and their healthy companion dogs in Adelaide (South Australia) were included in the study. To be included in the study, dogs were required to be/have: over 6 months of age; no history of aggression during veterinary visits; and no illness or medical condition that would cause pain. Dogs were excluded from the study if they usually required anxiolytic medication to attend their veterinary clinic, although dogs that were on medication for generalised (or other) anxiety were included, as the medication is administered regardless of veterinary attendance.

4.2.2. Data collection

4.2.2.1. Guardian Survey

Data collection was conducted in accordance with the methods described in Chapter 3. That is, guardians registered interest in the study through an online survey, and completed a larger survey onsite, while waiting in the neutral waiting room. The waiting room survey consisted of 33 questions pertaining to the physical examination study, and a further seven questions regarding the dog's history with nail trims, including: nail trim frequency (e.g. 'In general, do any of your dog's nails need trimming?'; 'How often would your dog's nails be trimmed on average in a year?'); Who has trimmed them (e.g. 'Who has trimmed your dog's nails in the past?'; 'Who trimmed your dog's nails the last time they were done?'); past experience (e.g.

‘Has your dog ever had a painful experience during nail trims (e.g. was the quick cut/ did they bleed?’); the dog’s response to different stages of the nail trim (e.g. ‘Please describe your dog’s response to the different aspects of having their nails trimmed by you or someone’, with pre-set options described in greater detail below); the extent they agree with a statement about investing in helping dogs cope better during nail trims (e.g. ‘Training your dog to help them feel more comfortable with nail trims’).

Two different aspects of nail trims were used in the survey to explore guardian-reported dog responses to the procedure: 1) the steps involved in a nail trim (e.g. picking up the paw, holding the paw, places clippers over nail and clips the nail), and; 2) the aspects of a whole nail trim procedure (e.g. clips the nails on the front paws, clips the dew claws, clips the nails on the back paws). Guardians were asked to report their dog’s response on a scale adapted by Overall (2013), and previously used in a veterinary context by Hernander (2008). The scale ranged from 1 (no stress/fear) to 5 (extreme stress/fear), and provided guardians with clear examples of what each level looked like (e.g. 1 = Calm, relaxed and seemingly unmoved (or friendly, outgoing, seeks attention; 5 = Extremely stressed, barking/howling, tries to hide/ escape, needs to be carried/ forced on lead).

4.2.2.2. Heart rate and behavioural responses

Heart rate responses were recorded with a Polar® M430 Watch and H10 Chest Strap (Polar Electro, Kempele, Finland), and behaviour was recorded in both the waiting room (with a Movii Neo Camera; TechBrands, New South Wales, AUS), and consult room, with: Panasonic® Lumix (Panasonic Corporation, Osaka, Japan), GoPro® Hero (GoPro Inc., California, USA) and Sony® Camera (Sony Corporation, Tokyo, Japan). The ethogram (Table 1) used to code the behavioural responses was developed for the studies from previous literature (Beerda et al. 1998; Csoltova et al. 2017), and utilised for behavioural observations in Chapter 3. Recordings were coded via continuous sampling with CowLog Software (Hanninen & Pastell 2009). The proportion of time spent performing the three stress-related behaviours (e.g. Ears Back, Tail Tuck and Pant) were summed for ease of analysis. Grouping individually measured behaviours has also been utilised by (Stellato et al. 2019) in their analysis of behavioural responses to a physical examination in a veterinary clinic.

Table 1: Ethogram of state (duration) behaviours during nail trim procedure, coded in mutually exclusive sets (e.g. EarsBack, EarsForward, EarsNeutral).

Behaviour	**Description**
Tail Tuck	Tail at lower than normal (breed standard) carriage (can be wagging), tip of tail curved in toward belly, tip of tail in line with hock or past line of hock.
Tail Neutral	Tail at neutral, mid-range height (for breed standard), most likely level or a little lower than rump, tail carriage relaxed
Tail High	Tail higher than neutral (for breed standard), may be wagging at any speed
Ears Back	Ears back or held lower than normal
Ears Neutral	Ears held in a neutral, relaxed state
Ears Forward	Ears held forward, open, higher than normal
Mouth Relaxed	Mouth mostly closed, relaxed flews (lips), no tension around eyes/ face. Commissure of mouth relaxed line or slight V-shape
Mouth Closed	Mouth fully closed, tense, tendons under eye seen
Pant	Mouth open with tongue extended accompanied with rapid breathing and expansion / contraction of the chest. Commissure of mouth pulled into a C-shape, tense lips

4.2.3. Testing procedure

Testing was conducted in March to May 2019, over eight weekend days. Each guardian and dog team spent approximately one hour on site in total, of which the nail trim procedure was a small part. The testing rooms were set up to simulate a standard veterinary clinic with an empty ‘waiting room’ and a ‘consult room’ next door. Appointment times were scheduled 1.5hrs apart to reduce the likelihood of any overlap between participants. Testing was conducted at two university teaching spaces in South Australia that had not previously been used for veterinary examinations or dog-related studies: Site 1 (CQUniversity Adelaide campus; *n*=28 dogs), and Site 2 (The University of Adelaide Roseworthy Campus; *n*=7).

4.2.3.1. Pre-nail trim procedure

The heart rate monitor was attached using Aquasonic®100 Ultrasound Transmission Gel (Parker Laboratories, New Jersey, USA) in the waiting room, prior to the guardian responding to the survey. The heart rate chest strap was fitted directly behind the dog's front legs (Figure 1a). The waiting period concluded once the guardian had completed the online survey. All dogs underwent the same testing order where the nail trim procedure occurred immediately after a standardised physical examination (see Chapter 3).

4.2.3.2. Nail trim procedure

The consult room layout at Site 1 is displayed in Figure 1b (Site 2 mirrored this). The nail trim procedure was conducted by the same trained 'examiner' (a qualified veterinary nurse and dog training professional with 10 and 6 years' experience respectively) for all dogs. The same researcher (P.E) also remained in the consult room throughout testing to ensure the heart rate connection remained consistent, and to observe for behavioural signs of aggression and ensure the dog did not become unduly distressed. The researcher requested guardians interact with their dog as they normally would during a veterinary situation (e.g. feeding treats, allowing the dog to sit on their lap, or assistance in restraint). Guardians were asked which nail clipper they used at home (or had seen used on their dog previously): a guillotine or scissor clipper. If they were unsure, a scissor clipper was used.

a) 

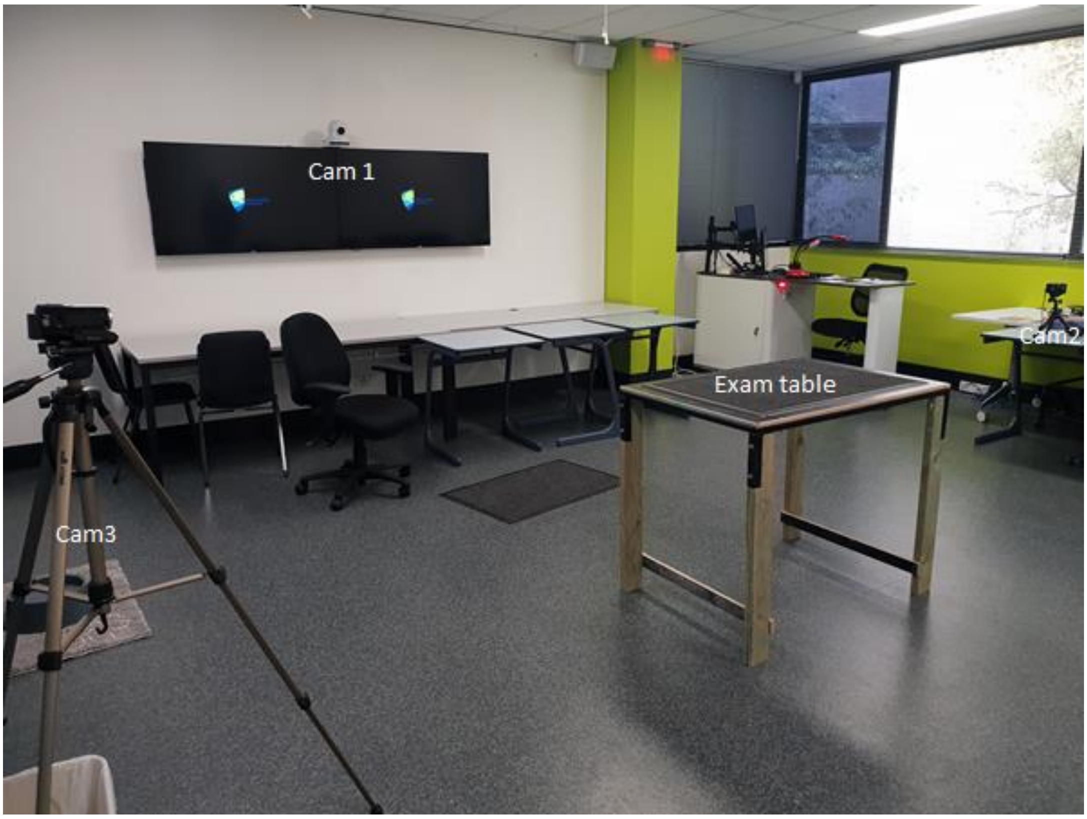
b) 

Figure 1a): Dog 27 (male, Swiss white shepherd) with heart rate monitor strapped to chest, during Front Right Nail Hold phase of nail trim procedure. Guardian (left) and examiner (right). **1b):** display of consult room set up at Site 1.

The nail trim procedure followed the standardised sequence of clinical activities outlined in Table 2, and was adapted from Seymour and van der Heiden (2009) and Orpet and Welsh (2011). The first two steps in the present study were included in order to assess a dog's reaction to a visual or audible nail clip stimulus. In an effort to reduce the risk of unnecessary distress, only one nail was clipped for each paw. The choice for which toe/ nail to isolate was made at the examiner's discretion and dependent on which nail needed clipping the most at the time of the procedure. A dried liver treat (size of an average thumbnail) was offered by the examiner after each successful nail trim, and at the end of the nail trim procedure.

Table 2: Sequence and description of clinical activities for completion of nail trim procedure.

Nail Trim step	Label	Description
1	Show	Show dog the nail clippers and allow to sniff if interested
2	Airclip	Clip the nail clippers within the dog's sight
3	RFLHold	Pick up right forepaw, and isolate a nail
4	RFLClip	Clip the nail
5	RFLTreat	Offer the dog a liver treat
6	RBLHold	Pick up right hindpaw, and isolate a nail
7	RBLClip	Clip the nail
8	RBLTreat	Offer the dog a liver treat
9	LFLHold	Pick up left forepaw, and isolate a nail
10	LFLClip	Clip the nail
11	LFLTreat	Offer the dog a liver treat
12	LBLHold	Pick up left hindpaw, and isolate a nail
13	LBLClip	Clip the nail
14	LBLTreat	Offer the dog a liver treat

A step of the nail trim procedure was ceased if the dog: struggled to the extent the examiner would normally require a second veterinary staff member to assist in restraint; showed behavioural signs of escalation to aggression; or at guardian request. In the event the distress observed was overly severe (e.g. a snap/ attempt to bite), the procedure was ceased completely (4 instances: Dog26 ceased at 1st step; Dog04 and Dog05 ceased at 2nd step; Dog13 ceased at 3rd step). A step was coded as a 'fail' if it was not completed for any of the above reasons. Where a 'hold' step failed, so too did the 'clip' and 'treat' for that step. Guardians were encouraged to interact with their dog the way they normally would during a nail trim procedure or veterinary examination (e.g. feed them food rewards, or interact with them positively).

If the heart rate did not change for the entirety of a step, that step was excluded (12 instances total). These were coded as a heart rate Fail, with the exception of the 'Clip' steps that, by definition, were only one second duration. Heart rate that remained consistent for 10 consecutive seconds or more in a step were removed, and the remaining heart rate for that step used to calculate the average (3 instances). Heart rate in the consult room was recorded from the start of 'Show' step to the end of the nail trim procedure (consumption of liver treat after LBL Clip).

4.2.4. Statistical Analysis

Statistical tests were conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corporation, New York, USA). Heart rate data and the sum of stress behaviours (e.g. Ears back, tail tuck and pant) were normally distributed (Shapiro-Wilk $p > 0.05$).

A Paired-Sample independent t-test was conducted to compare the average heart rate between the waiting room and the nail trim procedure. A multiple linear regression model was used to investigate the factors that predict mean heart rate during the nail trim procedure, with independent factors of sex, accept treat from examiner, failure rate, previous painful experience and sum of stress (e.g. proportion of time spent with ears back, tail tucked and panting). Behaviour and heart rate could not be analysed *within* each step of the nail trim procedure as individual steps were too short, and the delivery of a liver treat between each paw was a confounding factor. Associations between Acceptance of a treat and painful previous experience, failing at least one step and heart rate Group (whether the dog heart rate peaked above 180bpm) were assessed with Pearson Chi Square (Fisher's Exact) tests. Statistical significance was set at $p<0.05$, and all data are presented as mean ± SD unless otherwise stated.

Behavioural data was exported into a raw (.csv) Microsoft Excel 2016 (Microsoft Corporation, Washington, USA) file, and was parsed using the Practical Extraction and Reporting Language (PERL version 5.0; Wall 2021). PERL created correlated and consolidated Excel spreadsheets mapping each dog's behavioural response (for all behaviours) to specified times for each step in the nail trim procedure. The PERL coding rules are the same as those used in the related study investigating heart rate and behavioural responses to a physical examination procedure (Chapter 3) and can be found in that article's Supplementary Information.

4.2.5 Ethics statement

Guardians were informed about the general aims and testing procedures of the study prior to participating, and provided written consent before participation. This research was approved by the University of Adelaide Human Research Ethics Committee (approval number: H-2019-014), and the Animal Ethics Committee (approval number: S-2018-093), and conformed to national guidelines regarding use of animals in research.

4.3. Results

4.3.1. Descriptive results

A total of 35 dogs participated in the study. Dogs were mostly female (62.9%), neutered (86.6%), and of mixed breed (40%; Table 3). The mean dog age was 5.5 years old (±3.8yr) and mean weight was 20.5kg (±10.9kg).

Table 3: Dog demographics from 35 participants

Demographic	Number (%)
Sex	
Female	22 (62.9)
Male	13 (37.1)
Age (yr) Mean (±Std.Dev)	5.5yr (±3.8yr)
Neuter Status	
Neutered	31 (86.6)
Entire	4 (11.4)
Weight Mean (±Std.Dev)	20.5kg (±10.9kg)
Size	
Larger (>22kg)	21 (60.0)
Smaller (<22kg)	14 (40.0)
ANKC Breed Group	
Mixed breed	14 (40.0)
Working	9 (25.7)
Gundogs	6 (17.1)
Hounds	3 (8.6)
Utility	2 (5.7)
Non-sporting	1 (2.9)
Long term medications	
Not on medication	25 (71.4)
Behavioural medication (e.g. generalised anxiety disorder, separation anxiety)	5 (14.3)
Health medication (e.g. allergies)	5 (14.3)

A majority of dogs (*n*=23, 65.7%) underwent the nail trim procedure on the floor of the mock veterinary consult room, as the majority of guardians reported their dog would normally have their nails trimmed on the floor (either at home or within a clinic or other context). Just over half (*n*=19, 54.3%) had guardians that fed them treats at least once during the nail trim procedure, and 85.7% (*n*=30) of dogs took the liver treats from the examiner. The most common type of nail clippers guardians used at home were the scissor type (*n*=22, 62.9%).

4.3.2. Dog responses to a nail trim procedure in a mock veterinary setting

4.3.2.1. Heart rate and behavioural responses to nail trim procedure

The mean waiting room duration was 15.2 ±4.8 minutes and the mean nail trim duration was 2.07 ±0.78 minutes. Heart rate during the nail trim procedure was significantly higher (121.7 ±18.3bpm) than the baseline heart rate recording in the waiting room (97.3 ±19.0bpm; N=34; t (33) = -8.224, p=0.001). There was no significant difference in average heart rate during the nail trim between dogs that accepted treats (n= 30; 120.6 ±18.7bpm) and dogs that did not (n= 5; 131.4 ±12.9bpm, p> 0.05). Seven dogs had a heart rate peak over 180bpm during the nail trim, and the maximum heart rate observed during the nail trim was 229bpm (Dog 29, 3.5yo mixed breed, female, ~13kg). Supplementary Information Figure 1 provides a recorded example of the heart rate and behavioural responses to the complete nail trim procedure for Dog 28.

An example of a heart rate trace from a dog with heart rate that peaked over 180bpm (Dog29), and a dog that remained below 180bpm (Dog02) is provided in Figure 2. During the nail trim, Dog 29 heart rate increased rapidly during the show and air clip steps before the first nail trim, then decreased and remained relatively steady through the remaining steps in the nail trim, including with treats after each subsequent step. The heart rate for Dog 02 remained relatively consistent throughout, with minor peaks during the right back leg and left back leg hold steps.

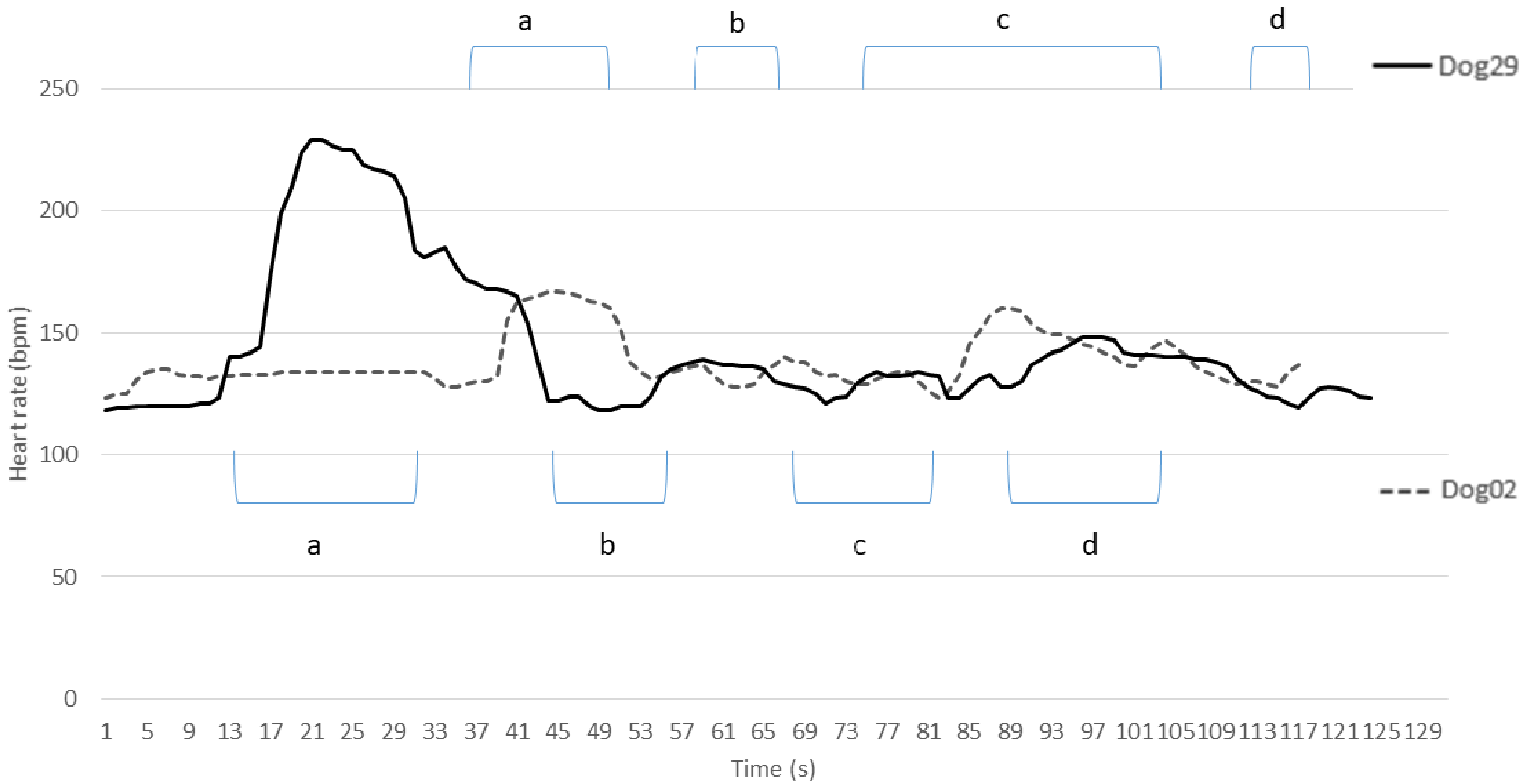


Figure 2: Heart rate trace examples from two dogs during the nail trim procedure, with key steps in procedure highlighted with letters: a) Right front leg hold; b) Right back leg hold; c) Left front leg hold; d) Left back leg hold.

A multiple regression was run to predict mean heart rate (bpm) over the whole nail trim from a model with factors of sex, whether the dog had experienced a painful trim in the past, accepted a treat from the examiner, had failed at least one step of the nail trim procedure, and the sum of proportion of time spent displaying stress behaviours (ears back, tail tucked and pant; Table 4). These variables significantly predicted heart rate; $F(5, 27) = 7.11$, $p < 0.001$, $R^2 = 0.568$. That is, approximately 56.8% of variation in heart rate observed was explained by these factors. However, only dog sex ($B = 19.69$, $t = 3.70$, $p < 0.001$) and sum of stress behaviours ($B = 0.191$, $t = 4.346$, $p < 0.001$) significantly added to the prediction. Mean heart rate for female dogs (n=22; 128.5 ±16.9bpm) was higher than male dogs (n=13; 111.2 ±15.1bpm); for female dogs, there was a 19.7 (bpm) increase in predicted heart rate. Other independent variables included in the regression did not add significantly to the predicted heart rate during nail trims. The median proportion of time a dog spent performing each individual duration behaviour can be found in Supplementary Information: Table 1.

Table 4: Factors that contribute to the model explaining variation of heart rate observed during a nail trim in 35 companion dogs.

Factors (reference)	**Unstandardised Coefficients (B)**	**95% CI for B (Lower-Upper)**	**t**	**p-value**
Female	19.69	8.77 – 30.62	3.70	<0.001*
Had experienced pain previously	0.13	-11.52 – 11.77	0.022	0.982
Accepted treat from examiner	10.59	-7.62 – 28.81	1.193	0.243
Failed at least one step	-1.45	-12.47 – 9.56	-0.271	0.789
Sum of Stress behaviours	0.191	0.101 – 0.281	4.35	<0.001*

4.3.2. Nail trim failure rates and other factors contributing to experience

The first two steps of the procedure (‘show’ and ‘airclip’) were able to be completed by all dogs without behavioural escalation of fear or aggression. Nearly half of dogs (n=16/33, 45.5%) failed at least one step of the nail trim. Most dogs failed the right front leg step (n=10/34, 29.4%), 6 dogs failed the right back leg (N=33) and left front leg (N=32) step (18.2% and 18.8% respectively). Reasons for failure are broken down as follows: struggled to the extent the examiner would normally require a second veterinary staff member to assist in restraint (*n* = 23 steps, Dogs 02, 03, 04, 05, 06, 10, 14, 18, 19, 22, 28, 30, 31, 33); showed behavioural signs of escalation to aggression (*n* = 13 steps, Dogs 13, 14, 20, 26); or at guardian request (*n* = 1 step; Dog10).

4.3.3. Guardian reported nail trim routine

From the survey, a majority of guardians reported their dogs need their nails trimmed (71.4%). Of those that required trims, twelve dogs (34.3%) require a nail trim two to five times per year, ten dogs (28.6%) have trims over five times per year and only three (8.6%) required a trim less than once per year. Interestingly, of those three, one guardian (Dog 04, 2yo, male neutered Aussie Shepherd) stated they have never been able to trim their dog's nails unless he was sedated at the veterinary clinic for another procedure; the dog simply became too distressed and the avoidance behaviours put the guardians or the dog at risk of injury. The procedure for Dog 04 was ceased at step 2 due to severe distress. Nearly half (45.7%) of guardians reported their dog's nails had been trimmed by different people in the past (e.g. self/family, groomer, veterinarian). Approximately half (48.6%) reported they did it themselves for the most recent nail trim, while 20% each of guardians reported the veterinarian and the groomer trimmed their dog's nails most recently. A more detailed summary of guardian responses can be found in Supplementary Information: Table 2. A majority of guardians responded they were likely or very likely to invest in training to help their dog cope with nail trims (82.9%).

4.3.4. Guardian reported previous experience of nail trims

Nearly a third of dogs had experienced a painful nail trim due to accident (e.g. cut the quick) at some time in the past (*n*=11, 31.4%), and 17.1% of guardians reported they were 'at fault' for that experience. Six guardians reported they or a family member responsible, three occurred when a breeder or trainer clipped the nail, and two occurred via a groomer. For those participants who provided additional information, the pain occurred in: dew claw on one of the front paws (*n*=1); one of the middle two claws on one of the front paws (*n*=1); Groomer and "old" vet both cut a quick [no paw location provided] (*n*=1); front right paw, but the dog showed no reaction (*n*=1); [dog] had toe nail removed by vet under sedation and restraint – rear right outside nail (*n*=1); can't remember/ no toe/paw location mentioned (*n*=3).

4.3.5. Associations with nail trim responses

Refusing to take a treat from the examiner (*n*=5) was significantly correlated with having a painful experience in the past (*n*= 11, X^2 = 6.081, *p* = 0.029); and failing at least one step of the nail trim procedure (X^2 = 5.211, *p*=0.031; Table 5).

Table 5: Frequency of dogs for each type of response to the nail trim procedure categorised by whether they had experienced a painful nail trim in the past.

	Accept treat from examiner		**X^2 (Fisher's Exact)**	**p-Value**
	No (*n*=5)	**Yes (*n*=29)**		
High heart rate (>180bpm) (*n*=7)	1	6	0.000	0.697
Low heart rate (<180bpm) (*n*=27)	4	24		
Previous painful experience (*n*=11)	4	7	6.081	0.029*
No previous painful experience (*n*=23)	1	22		
Failed at least one step (*n*=15)	0	16	5.211	0.046*
Passed all steps (*n*=18)	5	13		

*Indicates significance at the p <0.05 level

4.4. Discussion

Regular grooming and nail maintenance are an integral aspect of companion dog welfare and an important consideration for veterinary caseloads. Yet very little is known about how dogs experience nail trims or how that experience might impact responses in a veterinary context or other handling situations. The present study was exploratory in nature and aimed to provide some insight into companion dogs' experiences of nail maintenance from a convenience sample of 35 healthy, privately owned dogs in Australia. We suggest that undergoing a nail trim procedure could be a stressful event for companion dogs. During the standardised nail trim procedure in a mock veterinary setting heart rate increased significantly from baseline, although only one nail per paw was clipped, and nearly half of dogs 'failed' at least one nail clip in the procedure. Therefore, we emphasise the intensity of the physiological or behavioural responses may increase in situations where all nails are trimmed consecutively, in a real veterinary clinic which can evoke fear in a large proportion of dogs (Edwards, Hazel, et al. 2019) or in a context in which the dog is restrained or otherwise forcefully required to undergo a nail trim.

Nail trims resulted in physiological arousal based on heart rate. Heart rate was significantly higher in the simulated consult room in comparison to the waiting room. Approximately 56.8% of the variation of heart rate observed during nail trims was explained by the model, of which dog sex, and the sum of stress behaviours (ears back, tail tucked and pant) were significant predictors. Further, seven dogs (20%) in the present study had heart rate peak over 180bpm while at rest, which can be a sign of sinus tachycardia (Hackett 2015), and can cause serious risk to cardiovascular health if chronic, or acute but frequent. While a pilot study, behavioural and physiological responses observed during a nail trim reflect those reported elsewhere during similar handling or interaction-based experiences (Beerda et al. 1998; Csoltova et al. 2017; Edwards, Smith, et al. 2019; Stellato et al. 2020; and in Chapter 3). In contrast, Ferasin, Ferasin and Little (2010) suggest that a dog's behaviour at baseline (e.g. calm, excited, nervous) may be of greater significance in determining a dog's heart rate than their sex. This point of difference offers opportunity for future research.

Grooming can also impact the behaviour and physiological responses of domestic animals. Trimming hair has been associated with increased physiological signs of stress (e.g. salivary cortisol and eye temperature) in a preliminary study of 10 domestic horses (Yarnell, Hall & Billett 2013). The authors report no significant difference in physiological responses between horses that complied or did not comply with the trimming procedure. The lack of significant impact 'failure' rate had in the present study mirrors this; perhaps struggling and restraint affect animals differently than simply an increase in physiological arousal, or being *able* to struggle has some mitigating stress effect. In dogs, McGreevy, Righetti and Thomson (2005) reported a significant effect of duration of grooming in greyhounds and golden retrievers (*n*=28), whereby heart rate reduced over the eight minute period. The nail trim procedure was short (approximately two minutes) and so a similar habituation effect may occur in a longer nail trim experience. However, simply prolonging the procedure may result in a trigger stacking event similar to that described by Edwards, Smith, et al. (2019) for veterinary visits.

Evidence regarding the requirement and frequency of nail trims in companion dog populations is lacking. Of the 35 dogs in the present study, 10 (28.6%) guardians report their dog does not need nail trims, and 22 (62.9%) report trims are needed more than twice per year. The present study also provides the first indication that guardians may struggle to trim their dog's nails, based on the assumption they utilise other pet care professionals due to difficulty trimming their dog's nails and not as a matter of convenience. One guardian reported their dog required nail trims but they had never been able to trim them unless the dog was sedated at the veterinary clinic. Seymour and van der Heiden (2009) describe various medical-related causes of overgrown nails, but extreme fear responses during nail trims are not highlighted among them.

Nearly half of dogs ‘failed’ at least one step of the procedure due to excessive struggling or behavioural escalation to aggression. Struggling can indicate a negative reaction to restraint, which has been highlighted as a stress-inducing experience (Grandin 1998a, 1998b; Gregory 2004; Moberg 2000). Likewise, behavioural escalation to aggression causes similar concern for emotional welfare of the dog, and risk of injury to the handler (Overall 2013; Shepherd 2009; Yin 2009). However, in cases where nail trims are provided as a purchased service by groomers or veterinary clinics, the failure rate identified here may indicate a large proportion of dogs experiencing significant distress or fear if being forcibly restrained in order to complete the procedure. Further, approximately one third of guardians reported their dog had experienced a painful nail trim in the past. While anecdotally we know this occurs, this study offers the first indication of the potential frequency of such negative experiences in companion dogs. Howell and Feyrecilde (2018) suggest that great care should be taken to avoid these adverse experiences during nail trims as it will likely increase a negative reaction the next time. Similarly, negative experience resulting in future negative experience is identified within the veterinary context (Doring et al. 2009). More research is required with a larger representative sample to determine the prevalence of dogs that have had aversive experiences during nail trims, and how that impacts their responses over time.

Guardians reported that a variety of people had clipped their dog’s nails previously, including themselves or their family, the veterinarian/ veterinary nurse, groomers, breeders or trainers. This is the first study to identify guardians use a combination of services (and themselves) to trim their companion dog’s nails. As such, nail trims may contribute to the proportion of dogs becoming fearful or stressed within the veterinary context too. Dogs that received their first nail trim at an older age, and that are reported by their guardians as stressed or aggressive during body handling were more likely to be rated as fearful in the veterinary context (Stellato et al. 2021). Flint et al. (2018) identify that while educational intervention can improve a guardian's ability to accurately identify dog body language, the impact of such an intervention is lost when they are observing their own dogs; an apparent familiarity bias. This could pose a very serious risk of injury to guardians attempting to trim their dog's nails themselves if they are unable to objectively observe escalating behavioural signs of stress, fear or aggression. Additionally, dogs trained with positive punishment (the application of an aversive in order to reduce the frequency of unwanted behaviour) generally, or within the veterinary clinic specifically, were more likely to be rated as aggressive during veterinary visits (Stellato et al. 2021). In contrast, several sources highlight the value in training dogs for cooperative care, whereby they can choose to offer their own paw for nail trims (Becker et al. 2018; Howell & Feyrecilde 2018; Jones 2018; Monaco-Torelli 2018), or file their nails themselves on a scratchboard (Howell & Feyrecilde 2018). Professional groomers are also able to obtain a Fear-Free Groomer certification, one topic covered within is nail trims, to learn ways to actively reduce stress or fear at every step of a grooming process (FearFree 2016). As with veterinary care generally, guardians and animal care professionals offering nail maintenance services should make every effort to ameliorate stress or fear for the dogs in their care.

Remarkably little peer-reviewed evidence on nail trims in companion dogs exists; there is no established 'gold-standard' procedure, or recommendations on length, frequency or for optimal welfare. Dogs in the present study showed variation in the fear responses (e.g. some dogs' heart rate peaking over 180bpm while at rest and others remaining below; variation in behavioural responses). It is unclear whether the variation observed is due to inherent variation in touch sensitivity, or previous experience with restraint (generally, e.g. veterinarian), or nail trims (specifically). Interestingly, previous negative experience and failing at least one step (perhaps due to restraint) were not significant predictors of the variation of heart rate observed within the model. Perhaps other aspects of nail trims or previous experience not investigated here are of greater influence to a dog's response. Touch sensitivity in dogs can vary based on demographic or lifestyle factors (González-Ramírez, Quezada-Berumen & Landero-Hernández 2017; Hsu & Serpell 2003; Tamimi 2017). Dogs are also at risk of breed or lifestyle related disorders that affect the skin, limbs, bones or nails specifically (Neuber, 2009) and pain associated with handling, treatment or restraint likely contributes to a dog's negative experience even if unrelated to the nail trim specifically. The relationship between painful disorders, touch sensitivity, prevalence of skin or paw conditions or breed predispositions to abnormal structure or gait may provide valuable insight into a how a dog experiences nail trims or aspects of handling and restraint in a veterinary context.

4.4.1. Limitations

The aims of the present study were largely descriptive and exploratory in nature. As such, a convenience sample of 35 dogs and guardians was sufficient to meet our aims and highlight the value of future research in this field. While it does reflect sample sizes in similar fields (e.g. Csoltova et al. (2017)), it did limit the generalisability of the findings and a larger, representative sample is required for future investigations. The standardised procedure used for the nail trim (with a liver treat offered between each clip) was also a confounding factor in heart rate and behavioural responses. Although there was no significant difference in mean heart rate for dogs that did not accept the treat from the examiner (n=5). Likewise, only one nail was clipped per paw in this present study and so a longer procedure where all nails are clipped would reflect a more realistic experience for the dog, and greater duration would allow for more consistent heart rate observations. The behavioural and physiological responses in the present study may also have been influenced by the preceding physical examination in the mock veterinary setting and the results should be interpreted with caution. However, in cases where dogs receive their nail trims at the veterinary clinic, this process may reflect a similar order of events in real life.

The participants were recruited as part of a larger study investigating dog responses to a standardised physical examination (Chapter 3). As such, guardian responses may reflect a biased sample of those who have more knowledge or interest in how their dog behaves or responds to handling procedures generally. Some guardian responses to the survey may contain bias due to their ability to remember frequencies and experiences over time, and because no baseline knowledge regarding nail trims in dogs was gathered prior; we do not know if guardians accurately identified when their dog's nails needed trimming.

4.5. Conclusion

Nail maintenance is integral for companion dogs and, this exploratory study provides the first evidence of both that nail trims may be a stressful experience and guardians have a varied approach to nail maintenance. We highlight the importance of making every effort to reduce stress during recurrent procedures like nail trims to avoid long-term challenges that impact welfare and mental wellbeing. Finally, we emphasise the scarcity of peer reviewed evidence pertaining to nail trims currently and highlight the following avenues for future research: 1) a baseline measure of guardian knowledge, understanding and attitudes toward nail trims, and best practice recommendations from veterinarians or groomers; 2) prevalence and severity of nail-related injuries in companion dogs; 3) the extent to which overgrown nails can impact dog welfare, gait and movement; 4) the frequency and barriers (e.g. stress/ fear) to nail trims, and the impact of previous experience on those factors; 5) the relationship between nail trim requirement, exercise frequency and exercise substrates that may naturally wear nails down, 6) best practice and low stress handling approaches to nail trims, and; 7) the role different animal care professions (e.g. veterinary professionals, trainers, groomers, breeders, etc.) may have on the way a dog experiences nail trims or handling practices generally.

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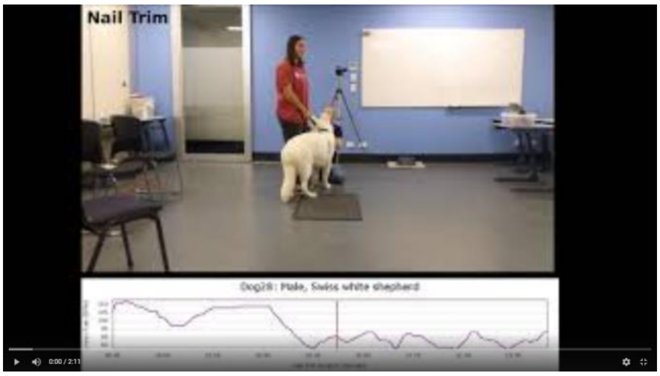
4.8. Chapter 4: Supplementary Information

4.8.1. Supplementary Information Figure 1:

Example of the heart rate and behaviour for the nail trim procedure in Dog 28 (male, Swiss white shepherd).



Youtube link (Unlisted): https://youtu.be/BYz6e53S7Jg

4.8.2. Supplementary Information Table 1:

Median proportion of time in sight spent performing a duration behaviour during the nail trim procedure for 35 dogs. Behaviours are coded in mutually exclusive sets (e.g. Tail High, Tail Neutral, Tail Tucked).

Behaviour	**Median (Min-Max)**
Tail High	0.00 (0.00-97.06)
Tail Neutral	60.00 (0.00-100.00)
Tail Tucked	0.00 (0.00-100.00)
Ears Forward	20.75 (0.00-100.00)
Ears Neutral	0.00 (0.00-61.64)
Ears Back	67.54 (0.00-100.00)
Mouth Relaxed	0.00 (0.00-100.00)
Mouth Closed	93.10 (0.00-100.00)
Pant	0.00 (0.00-100.00)

4.8.3. Supplementary Information Table 2

Guardian (*n*=35) reported routines for nail trim procedures

Response variable	Frequency (%)
Nail trim required (generally)	
Yes	25 (71.4)
No	10 (28.6)
Nail trim frequency	
Never	10 (28.6)
Less than once per year	3 (8.6)
2-5 times per year	12 (34.3)
Over 5 times per year	10 (28.6)
Nail trimmer (Who has trimmed your dog's nails?)*	
Combination	16 (45.7)
Guardian/family	10 (28.6)
Groomer	2 (5.7)
Veterinarian	2 (5.7)
Not applicable/ don't know	5 (14.3)
The most recent nail trimmer	
Guardian/Family	17 (48.6)
Groomer**	7 (20.0)
Veterinarian/Veterinary nurse**	7 (20.0)
Never been done	3 (8.6)
Breeder/Trainer	1 (2.9)
Accident/Pain in the past	
No	23 (65.7)
Yes	11 (31.4)
Not sure	1 (2.9)

*Guardians could select more than one

**Some guardians who selected their dog's nails never needed trimming generally, reported they had been done by this professional most recently

Chapter 5

Stress reducing veterinary care within the Australian veterinary industry: Attitudes and barriers to implementation

Introduction

One of the aspects of mitigating fear and stress in a dog's veterinary experience that was highlighted in Chapter 1 included investigating the extent to which veterinary professionals in the industry feel they have the capacity to implement these strategies. Where Chapters 2 to 4 focused on identifying potential causes of fear of the veterinary clinic from either genetic or handling and environmental perspectives, Chapter 5 investigates the potential for change as a whole. An online survey was used to investigate the Australian veterinary industry's attitudes to stress reducing veterinary care, and their beliefs regarding barriers to implementation. Chapter 5 offers a novel contribution to our understanding of veterinary attitudes toward improving welfare in the veterinary context through content-driven, qualitative analysis of free text responses. This is the first study of its kind to address attitudes of the veterinary industry within Australia for mitigating stress in daily practice, but has global implications for outcomes considering the similarities within companion animal practice internationally.

Statement of Authorship

Title of Paper	Care for canines within the Australian veterinary industry: Attitudes and barriers to implementation to stress reducing veterinary care
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Principal Author

Name of Principal Author (Candidate)	Ms. Petra Edwards		
Contribution to the Paper	Conception Acquiring Data Knowledge/ Methodology Analysis Drafting Reviewing & Editing		
Overall percentage (%)	70%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	29/11/2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

iv. the candidate's stated contribution to the publication is accurate (as detailed above);

v. permission is granted for the candidate in include the publication in the thesis; and

vi. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Dr Susan Hazel		
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Contribution to the Paper	5% Conception Analysis Reviewing & Editing		
Signature		Date	3/12/21

Abstract

Stress reducing veterinary care (aka. 'fear-free'/ 'low stress') describes a standard of veterinary care that aims to incorporate a proactive, practical approach to reducing fear and stress in companion animals in the veterinary context. However, the attitudes of the Australian veterinary industry towards these techniques is not well understood. This study aimed to provide an initial benchmark the frequency of low stress handling/ fear reduction certifications among the Australian veterinary industry, and investigate factors that predict veterinary professional attitudes toward stress reducing veterinary care. Veterinary professionals (veterinarians, veterinary nurses and others in the industry; *n*= 291; 91% female) were asked about their attitudes and certification status using an online survey. One in five (*n*= 56) participants reported having a stress reducing veterinary care certification (Fear-Free™ Veterinary Professional, or similar). Respondents generally had positive attitudes toward stress reducing veterinary care (*Mdn*=415.0; range=487; Scale Min=0, Max=500). A general linear model (GLM) was used to investigate factors that predict attitudes toward stress reducing veterinary care. Approximately 10% of the observed variance in those attitudes was explained by the model. Of the factors (gender, age, role in industry and certification status) and covariates (attitudes to animals scale; AAS) investigated, only AAS (p=0.006; F=7.829, μ^2=0.035), and certification status (p=0.031; F=4.733; μ^2 = 0.021) were significant. Professionals with a certification reported higher frequency of use, and agreed they had the clinical environment to use fear-free techniques in comparison to those without a certification (Mann Whitney U-test, p=0.005 and p=0.001 respectively). Content analysis of open-ended questions revealed that barriers to implementation centred around themes of: workplace and practice management, colleagues, clients, clinic environment, work-specific conflict, personal abilities, and patients. While stress reducing veterinary care may be important to veterinary professionals, there are a multitude of challenges that need to be addressed before stress reducing veterinary care can be effectively and consistently adopted by the industry.

5.1. Introduction

Companion dogs can become distressed or aggressive during routine veterinary visits. Guardians (owners) report up to one in seven dogs show severe or extreme fear during veterinary examination (Edwards, Hazel, et al., 2019), while other estimates suggest between 10% and 78% of dogs become fearful or stressed within a veterinary clinic (Csoltova et al., 2017; Doring et al., 2009; Edwards, Hazel, et al., 2019; Godbout et al., 2007; Hekman et al., 2012; Hernander, 2008; Mariti et al., 2017; Mariti et al., 2015; Overall, 2013; Stanford, 1981; Vaisanen et al., 2005). A dog's independent characteristics (e.g. breed, size) contribute a very small proportion to the variation of fear observed in the veterinary context (Edwards, Hazel, et al., 2019), and so their response likely hinges more closely on their previous experience and the current veterinary environment (Edwards, Smith, et al., 2019). The variation and complexity involved in the cause and development of fear in the veterinary context likely results in an equally variable solution between patients.

Dogs show more behavioural and physiological signs of fear as they enter the consult room in a real veterinary clinic (Doring et al., 2009; Lind et al., 2017) and a mock veterinary clinic (Csoltova et al., 2017) in comparison to the waiting room. Behavioural signs of fear in dogs also vary across different phases of physical examination (e.g. examination of the head, body palpation, etc.; Stellato et al., 2020; Stellato et al., 2021), and increase in conjunction with some physiological signs of fear if the guardian is absent, or not communicating positively with them (Csoltova et al., 2017; Stellato et al., 2020). Dogs fearful of their veterinary care are more likely to react aggressively to veterinary staff (Frank, 2014), and dogs were more likely to be rated as 'aggressive' in a veterinary clinic if they were reported as fearful of the veterinarian by their guardians (Stellato et al., 2021). In fact, dog and cat bites are listed as a major contributor to physical injuries in veterinarians and veterinary nurses (Fritschi et al., 2006; Jeyaretnam et al., 2000; van Soest & Fritschi, 2004). Dogs with negative experiences are more likely to respond fearfully during the next consult (Doring et al., 2009), and fear also inhibits the provision of quality veterinary care as the physiological signs of fear are very similar to those of pain or some neurological conditions (Frank, 2014). As such, the quality of care provided to companion animals and the occupational welfare of veterinary professionals depends on addressing fear in the veterinary context.

Specific, proactive and creative strategies to reduce fear or distress in the veterinary context have developed over the years, with ‘fear-free’, ‘low stress’ or ‘pet-friendly practice’ approaches, continuing education certifications, and research, becoming increasingly popular (CattleDogPublishing, 2018; Csoltova et al., 2017; Demaline, 2018; Doring et al., 2009; Edwards, Hazel, et al., 2019; FearFree, 2016; KarenPryorAcademy, 2017; Lloyd, 2017; Moffat, 2008; Riemer et al., 2021; Stellato et al., 2020; Stellato, Hoffman, et al., 2019; Stellato, Jajou, et al., 2019). Similarly, there is a wealth of grey literature available for learning more about stress reducing veterinary care from a guardian or veterinary professional perspective (Becker et al., 2018; Howell & Feyrecilde, 2018; Jones, 2018; Monaco-Torelli, 2018; Overall, 2013; Yin, 2007). Bain (2020) emphasises the critical importance of treating animals as a ‘whole’; that veterinary medicine is both surgical and behavioural in nature, and Heath and Wilson (2014) argue facilitating mental wellbeing in patients is a fundamental aspect of the duty of care of veterinarians. Learning more about behaviour, body language and learning theory are invaluable foundations to any veterinary or veterinary nurse education, or ongoing professional development. Therefore, pursuing additional professional development or certification opportunities in ameliorating fear or distress in the veterinary context may be of critical import to veterinary professionals, yet little is known about whether veterinary professionals pursue certifications in this area and their attitudes toward stress reducing veterinary care specifically targeted at reducing fear in general. For ease of readability, the term ‘stress-reducing’ is used throughout to encompass strategies to reduce fear during veterinary practice that may be recommended by literature, or within professional development programs (e.g. ‘Fear-free pets’ or ‘Low stress handling University’).

Further, Edwards, Smith et al. (2019) highlight the complexity of a veterinary visit with the stakeholders involved (veterinarian, client and patient), and potential barriers to implementing strategies to mitigate stress in the veterinary context through the psychological lens of the Theory of Planned Behaviour (TPB; Azjen, 1991). The TPB encompasses the potential for successful behaviour change (e.g. implementing strategies to reduce fear in a veterinary clinic) depends on the individual’s attitudes about the behaviour, the attitudes of those around them (subjective norms), and their perception of control over the behaviour and ability to perform it (perceived behavioural control). While research investigating the feasibility of improving welfare for dogs during veterinary visits exists (e.g. Dawson et al. (2016) and Arhant et al. (2019)), little has been done to consider how successful implementation of strategies to reduce stress can be implemented effectively and practically.

The present study aims to benchmark the prevalence of individual certification in programs for reducing stress during veterinary care in the Australian veterinary industry, and determine the veterinary industry attitudes toward stress reducing veterinary care and its implementation in clinical practice. A secondary aim was to determine the factors associated with importance of fear-mitigating practice, including gender, role within the industry (e.g. veterinarian, veterinary nurse), certification status, and attitudes to animals in general.

5.2. Methods

5.2.1 Participants

A sample of 333 participants were recruited by generic practice email addresses sourced online via the Yellow Pages (www.yellowpages.com.au; Accessed 1 Nov 2019), with a search for 'Veterinary Clinic' in each Australian State or Territory. Generic emails for the first five search pages were recorded, and a total of 760 emails to veterinary practices inviting industry professionals to participate in research were sent in January 2020, with a follow up reminder in February 2020. Recruitment also occurred via veterinary-related social media groups throughout December 2019 to March 2020. Veterinary professionals were invited to participate in the research if they: were over the age of 18 years old, lived and worked in Australia, were fluent in English, worked with small animals (or were studying to work in small animal practice), and worked with dogs specifically.

5.2.2. Measures and Procedures

An online survey was developed containing a total of 50 questions, including: demographic and work/study related information (*n*=9); their familiarity with stress reducing veterinary care (e.g. please indicate whether you have completed any of the below formal stress reducing certifications/ is the clinic/ practice you work in advertised as 'fear-free'; *n*=4); their attitudes toward stress reducing veterinary care (e.g. 'fear-free' veterinary care is important to me/ my clients/colleagues/workplace, etc.; *n*=5); questions about implementing stress reducing veterinary care (e.g. how often do you use 'fear-free' techniques with dogs in your daily practice?/ how often do you use [specific strategy]; *n*=10), and; their attitudes to animals (Herzog et al., 1991; *n*=20). The survey also included two free-text questions: 1) Are there any other fear-free techniques you use frequently that you feel are important to helping reduce fear or stress in dogs during veterinary visits?, and; 2) What do you think are the barriers for implementing ‘fear-free’ veterinary care in clinical practice?

Questions regarding levels of importance of stress reducing practice were chosen to encompass the various stakeholders within the veterinary industry (e.g. colleagues, individuals and clients), and responses were based on the extent to which participants agreed with the premise on a scale of 0 (Strongly disagree) to 100 (Strongly agree). Frequency of use in general (e.g. how often do you use stress reducing veterinary care techniques in daily practice?) and with specific examples (e.g. how often do you use calming or enriching scents in at least one location in the clinic?) were asked on a scale of 0 (Never) and 100 (Always).

The attitudes to animals scale (AAS) is a standardised, validated survey used to assess a person’s ethical and moral beliefs about treatment and use of captive or wild animals (Herzog et al., 1991). The scale comprises 20 questions scored on a 5-point Likert scale (from 1= strongly agree to 5= strongly disagree) and focuses on use of animals in research, recreation (e.g. hunting/ zoos), clothing or food. Examples of questions include: ‘I do not think there is anything wrong with using animals in medical research’ and ‘it is unethical to breed purebred dogs for pets when millions of dogs are killed in animal shelters each year’. Some aspects of AAS questions had to be tailored to suit Australian population (e.g. ‘racoon’ was changed to ‘possum’). AAS has excellent internal reliability (α=0.88; Herzog et al., 1991).

5.2.3. Quantitative Analysis

The quantitative responses were cleaned in Microsoft Excel 2016 (Microsoft Corporation, Washington, USA) using the following criteria: Practice type ‘other’ includes combined GP *and* specialist clinics (*n*=3), shelter clinics (*n*=3) and N/A (for those currently unemployed or students; *n*=8); the current role ‘Vet’ includes locum vets (*n*=2) and ‘Specialist vets’ (including behaviour vets; *n*=2); and, 'Other' refers to receptionists, kennel hands, practice managers, and veterinary and veterinary nursing students. Age was provided as a free text option and grouped into categories, while gender was only analysed as female or male as the other options provided ('non-binary' and 'prefer not to say') only included 1 respondent each. Certified refers to any certificate that a professional has completed in addition to gaining their initial qualification allowing them to work in the veterinary field. This includes certificates from: Fear-Free Pets (Levels 1, 2 or 3) and Low Stress Handling University (Silver or Gold); 'other' certification refers to graduates of Fear-Free Pets (training, grooming or shelter professionals), Karen Pryor Academy's Better Veterinary Visits online course, current students of any stress reducing certification course, or a relatively new Australian-based 'Stress-free certification' (*n*=1).

Cronbach's alpha was conducted on groups of questions within the same category to assess inter-variable reliability, with α>70.0 considered acceptable (Tavakol & Dennick, 2011). As such, questions regarding the level of importance of stress reducing veterinary care (*n*=5; α=0.779), frequency of use generally (*n*=3; α=0.836), frequency of use of specific techniques (*n*=7; α=0.765), and AAS (*n*=20; α=0.897) were analysed using the sum of those responses.

5.2.4. Statistical analysis

Statistical analyses conducted in IBM SPSS Statistics for Windows, Version 26.0 (IBM Corporation, New York, USA). Responses to the importance of stress reducing strategies, clinical ability, frequency of use, and examples of stress reducing techniques were not normally distributed (Kolmogorov-Smirnov $p<0.05$), and responses to AAS were normally distributed (Kolmogorov-Smirnov $p>0.05$). Chi-square analysis was used to investigate the relationship between certification status and clinics that advertised as 'fear-free'. A build terms (main effects) univariate general linear model (GLM) was used to investigate which factors predict a respondents' perceived importance of stress reducing veterinary care. The outcome measure was the sum of level of importance, with fixed factors of gender, age category, role in the industry and certification status, and covariate of AAS responses. Mann Whitney U tests were also used to compare the self-reported agreement toward clinical ability to implement stress reducing strategies and frequency of use based on certification status. Significance was set at the $p<0.05$ level.

5.2.5 Qualitative Data Analysis

Analysis of the free-text responses was conducted using a content analysis approach first described by Braun and Clarke (2006), and similar to that described in animal-related studies elsewhere (Bussolari et al., 2021; Nieforth et al., 2021; Packer et al., 2020). At the completion of data collection, responses to the two free-text questions (regarding techniques used and barriers to implementation) were analysed in separate worksheets in Microsoft Excel. Free-text comments were categorised and split by content-driven theme development through an iterative process by the authors (similar to Packer et al. (2020). Each tab contained a theme, with individual free text responses in each row. Subthemes generated by a participant's response were coded in columns. One statement could be coded for multiple themes/subthemes. For example, in barriers to implementation, the quote "time constraints. Need for trx vs. stress is sometimes more important for the animal […]" (ID3) was coded to Theme/subtheme: Workload/workload, and 'The nature of the job'/ competing priorities. The content within each theme/subtheme was developed by the primary author, then discussed between authors, and finally a subset reviewed by a fifth, independent researcher for consistency and areas of disagreement.

5.2.6. Ethical statement

Participants ‘opted-in’ to the survey, were informed about the general aims and testing procedures of the study prior to participating and provided consent before participation. This research was approved by the University of Adelaide Human Research Ethics Committee (approval number: H-2019-245).

5.3. Results

5.3.1. Descriptive data

A total of 333 people responded to the survey. However, 42 (12.5%) were excluded because they did not complete the demographic information or were not employed/studying in the veterinary industry (or in small animal practice with dogs), leaving 291 responses to analyse. The largest proportion of respondents were from South Australia and New South Wales (approximately 22% each), were female (91%),worked full time (49%) in private instead of corporate practice (80%; see Table 1). The most common age category was 18-29 years old, and the median duration in the current role was 4 years (0yr-47yr).

Table 1: Demographic and practice-related information from 291 participants in the Australian veterinary industry.

Demographics	**Total n (%)**
Gender (N=291)	
Male	24 (8.2)
Female	265 (91.1)
Age Group (N=291)	
18-29yr	112 (38.5)
30-39yr	81 (27.8)
40-49yr	56 (19.2)
50yr>	42 (14.4)
Qualification (N=290)	
Veterinarian	116 (39.9)
VeterinaryNurse CertIV	131 (45.0)
Other[1]	43 (14.8)
Graduation Year (N=287)	
1952-1972	8 (2.7)
1973-1982	12 (4.1)
1983-1992	16 (5.5)
1993-2002	40 (13.7)
2003-2012	67 (23.0)
2013-2020	128 (44.0)
Student	16 (5.5)
Practice Type (N=291)	
Small Animal GP	187 (64.3)
Mixed Animal GP	48 (16.5)
Small Animal Specialist	35 (12.0)
Mixed Animal Specialist	7 (2.4)
Other	14 (4.8)
Current Role (N=290)	
Veterinarian	86 (29.6)
Veterinary Nurse	138 (47.4)
Other[2]	66 (22.7)

Employment (N=291)	
FullTime	143 (49.1)
PartTime	93 (32.0)
Casual	39 (13.4)
Student	7 (2.4)
Locum Veterinarian	3 (1.0)
Locum Veterinary Nurse	2 (0.7)
None	4 (1.4)
Corporate (N=291)	
No	233 (80.1)
Yes	52 (17.9)
N/A	6 (2.1)
State (N=278)	
SA	64 (22.0)
NSW	63 (21.6)
VIC	51 (17.5)
WA	37 (12.7)
QLD	32 (11.0)
TAS	23 (7.9)
NT	2 (0.7)
ACT	1 (0.3)
N/A	5 (1.7)

[1]Other certifications include: veterinary nursing student (*n*=19), veterinary technician student (*n*=8), Veterinary student (*n*=5), none (*n*=6), and 'other' (*n*=5).
[2]Other roles include: management (*n*=27), Specialist Veterinarian (*n*=16), Reception/ kennel attendant (*n*=13), and 'other' (*n*=10).

5.3.2. Certification in Australia

A total of 56 (19.2%) of respondents had some form of certification (Table 2). The most common certificate gained was the Fear-Free for Veterinary Professionals™ (any level) certification (*n*=27). Approximately 20% of veterinary professionals reported that their clinic advertised as 'fear-free' or 'low stress'. Individuals with a certification were significantly more likely to be working in a clinic that advertised as ‘fear-free’ (n = 272; X^2 = 65.75, p<0.000). There was no association between certification and current role in the veterinary clinic (n= 277; X^2 = 0.205, p=0.651).

Table 2: Stress reducing certification information of 291 Australian veterinary industry participants.

Certification Status	**Total n (%)**
Certification status (N=278)	
Certified	56 (20.1)
Not certified	222 (79.9)
Certification Type (N=278)	
None	222 (79.9)
Fear-free for veterinary professionals (FFVP)	27 (9.7)
Low stress handling university (LSH)	8 (2.9)
FFVP_LSH	4 (1.4)
Other[1]	17 (6.1)
Clinic advertised as ‘Fear free’ (N=290)	
No	227 (78.0)
Yes	57 (19.6)

[1]Other certifications include: Fear-Free™ for Trainers, Groomers, or Shelter staff, Karen Pryor Academy Better Veterinary Visits, Less Stress For Pets.

5.3.3. Importance of stress reducing veterinary care

Overall, 172 respondents (59.1%) had a total Sum of (using stress reducing strategies) Importance score over 400 (out of 500). The responses for each importance question can be found in Supplementary Information: Table 1.

5.3.4 Factors associated with importance of stress reducing veterinary care

Approximately 10% of the variation observed in importance of stress reducing veterinary care was explained by the GLM, of which Fear-free certification status (p=0.031) and AAS (p=0.006) were significant predictors of a respondent's perceived level of importance (Table 3). Certification status contributed approximately 21% and AAS explained approximately 35% of the effect. That is, those with a certification and those with more positive attitudes to animal welfare were more likely to have positive attitudes to stress reducing veterinary care.

Table 3: General linear model summary for factors predicting veterinary professional attitudes (importance) to stress reducing veterinary care.

Source of Variance	Mdn level of importance (min-max)	B (95% CI)	DF	Mean square	F	Sig.	Partial Eta Squared
Corrected Model			8	16477.86	3.060	0.003*	0.101
Intercept		372.73 (301.77-443.69)	1	549486.16	102.03	<0.001*	0.318
Gender (n = 289)			1	12403.51	2.30	0.131	0.010
Female (n=242)	416.5 (13.0-500.0)	0					
Male (n=22)	380.0 (153.0-500.0)	-27.41 (-63.01-8.19)					
Age (n=291)			3	11882.35	2.21	0.088	0.029
18-29yr (n=99)	413.0 (180.0-500.0)	-31.32 (-63.23-0.59)					
30-39yr (n=76)	409.0 (13.0-500.0)	-41.18 (-73.20- -9.15)					
40-49yr (n=52)	407.0 (153.0-500.0)	-34.01 (-68.12-0.10)					
>50yr (n=37)	450.0 (288.0-500.0)	0					
Role (n=290)			2	1809.81	0.34	0.715	0.003
Veterinary Nurse (n=122)	412.5 (104.0-500.0)	-9.64 (-35.69-16.41)					
Veterinarian (n=81)	401.0 (13.0-500.0)	-10.04 (-36.62-16.54)					
Other (n=61)	420.0 (205.0-500.0)	0					
Fear-free certification (n=264)			1	25489.78	4.73	0.031*	0.021
Not certified (n=210)	408.0 (13.0-500.0)	-26.48 (-50.46- -2.49)					
Certified (n=54)	430.0 (180.0-500.0)	0					
AAS (n=228)		1.14 (0.34-1.94)	1	42162.14	7.83	0.006*	0.035

* indicates significance at p < 0.05 level

0 = reference parameter

5.3.5. Stress reducing veterinary care – reported frequency and ease of use

Certified professionals were significantly more likely to agree they had the environmental set up to use stress reducing veterinary care techniques than those without a certification (see Table 4). Similarly, respondents with a certification were significantly more likely to report they use (general) stress reducing veterinary care techniques more frequently and employ specific techniques more frequently in comparison to those without a certification. Participant responses relating to frequency of use can be found in Supplementary Information: Table 2.

Table 4: The level of agreement regarding clinical resources, ability to implement and frequency of use of stress reducing veterinary care (SRVC) techniques in daily practice.

	Median (min-max)		**Mann-Whitney U Test**
Total attitudes	**Not Certified**	**Certified**	***p*-value**
I have the clinical resources to implement SRVC*	70.0 (0.0-100.0)	83.0 (6.0-100.0)	0.060
My clinic environment is set up to use SRVC*	64.0 (0.0-100.0)	80.0 (0.0-100.0)	0.031*
Sum frequency of use of SRVC techniques generally	223.0 (20.0-300.0)	265.0 (0.0-300.0)	0.005*
Sum frequency of use of Example SRVC techniques provided	473.0 (86.0 – 700.0)	575.0 (165.0-700.0)	0.012*

* indicates significance at $p < 0.05$ level

5.3.6. Commonly reported stress reducing veterinary care techniques used

A total of 154 respondents also provided free-text responses on strategies they currently employ to reduce stress or fear in the veterinary context, from which five themes developed (Table 5). These themes are (in order of highest to lowest frequency): 'Handling and interactions' (*n*=88); ; 'Training and distractions' (*n*=66); 'Environment and patient management' (n=64); 'Pharmaceutical intervention' (*n*=58), and; 'Prevention' (*n*=16). Within handling and interactions, adopting various approach strategies and minimal handling and restraint were reported most commonly as a technique veterinary professionals in Australia are currently using.

Table 5: Content-driven themes (and subthemes) of additional stress reducing veterinary care strategies currently employed by respondents in clinical practice, in order of frequency of responses, with examples.

Theme/ Subtheme	**Example quote/s**	**Number of responses**
Theme 1: Handling and interactions (n=88)		
Approach Strategies	"Assess dog's demeanour before handling, allowing them to sniff me and using a calm soothing voice and trying not to make sudden movements." (ID163)	27
Minimal handling/restraint (e.g. need vs. want)	"Trimming nails by not lifting feet if not accommodated." (ID28) "Only examining what is really vital (eg no temperature for routine healthy animals)" (ID33) "breaks and calming down during handling when patients getting too stressed." (ID226)	24
Minimally aversive	"Clipping and placing numbing cream on admission to facility blood draws and catheter placement" (ID52) "Talk calmly with my patients, if they allow it I offer them cuddles […]" (ID108) "Removing choker chains on entry to my consult room." (ID189) "patting the dog and sitting with them" (ID333)	19
Social support	"Bring other housemates in that are known to be fond of coming to the clinic" (ID184) "Usually try to find one staff member to be the main carer for that dog & sometimes a trust is formed." (ID216) "For highly anxious patients, keeping clients close to reduce anxiety or sometimes keeping clients away (depends on circumstances) when performing a small procedure (e.g vaccination, blood taking, nail trim)" (ID230)	16

Other	"[…] t touch" (ID105) "[…] we try and have a male vet or female vet ready if the patient has a preference for one over the other […]" (ID202)	2
Theme 2: Training & distractions (n=67)		
Food (unspecified use)	"Treats the dog likes - cheese/chicken" (ID176) "[…]treats in the consult room and waiting room[…]" (ID236)	45
Distractions/enrichment	"Vegemite on muzzle if absolutely needed to entice placement of muzzle." (ID208) "Throwing treat scatters in the consult room and encouraging snuffling, using a licky mat where possible to do injections/nails/bloods etc" (ID266)	19
Training	"Positive reinforcement and training for exams" (ID3) "Use of treats for encouraging attention, rewarding, luring onto scales etc." (ID28) "Positively reinforce items such as stethoscopes." (ID220)	3
Theme 3: Environment and patient management (n=64)		
Exam Location/ Environment	"Seperate hospitals for cats and dogs […]" (ID18) "An enclosed grassy area outside where we can consult with those dogs that are too scared to come inside." (ID29) "A second entrance so frightened dogs can come in away from other dogs" (ID29) "starting consult in car park for new/anxious patients before coming inside" (ID68)	29
Sensory intervention	"Adaptil on toys and mats prior to the dog coming in so it's set up, ready to go" (ID13) "Ceva calm clinic protocol - lights out in the kennel rooms - music playing quietly" (ID132) "Calming Music in the kennel room, adaptal/fenpral where possible" (ID300)	21

Patient management (e.g. records/ scheduling)	"Taking animals immediately into consult or allowing them to remain in the car/car park until consultation." (ID30) "Reception staff assess and advise patients to stay outside if anxious, can use outside area for examination if required." (ID78) "[…] appropriate consult booking to minimise waiting rooms times […]" (ID132) "[…]booking appointment for stressed patients at quieter times." (ID170)	11
Other	"[…] anxiety jackets […]" (ID53) (ID277) "Calming caps used for blood collections , nail clips etc." (ID89)	3
Theme4: Pharmaceutical intervention (n=58)		
Anxiolytics	"[…]anxiolytics either in clinic for completion of exam or procedures." (ID44) "I work in specialty/ ER practice. Most hospitalised patients have trazadone/gabapentin used to help reduce stress and anxiety." (ID143)	24
Pre-visit pharmaceuticals	"We use "fear free medication" eg. single once off doses or behavioural medications for patients who may need this to assist in having a fear free visit. These are of various combinations but commonly we use gabapentin for cats and trazadone and clonidine for dogs. The owner will give them about an hour before the vet visit." (ID287)	23
Sedation	"[…]pre-anaesthesia sedation prior to intravenous catheter placement" (ID154) "[…]chemical restraint" (ID282)	9
Other (supplements)	" […]comfort packs (zylkene, traz/gabapentin, adaptil/feliway bandanna etc) prior to visit." (ID86) "[…]supplements e.g. zylkene […]" (ID 97)	2

Theme5: Preventative (n=16)		
Social visits	"Social visits prior to actual vet visits " (ID65) "Happy visits - visits to the vet for treats and playtime without having a consult or vaccinations to be done." (ID82)	10
Education	"Training owners in the use of basket muzzles if they have an aggressive pet." (ID29) "[…] talking with owner with what's best for pet […]" (ID72) "Client education raise, educate & train their dogs not to be so fearful and excessively dependent on their owners." (ID186)	5
Other	"calming the client is as important to overall calmness of pet-" (ID128)	1

5.3.7. Reported barriers to implementing stress reducing veterinary care

A total of seven themes developed from 216 free-text responses to 'barriers to implementing fear-free practice' (Table 6). These themes are centred around (in order of highest to lowest frequency): 'Workload' (*n*=143); 'Workplace' (*n*=78); 'Education' (*n*=73); 'Resources' (*n*=59); 'Clients' (*n*=48), and; 'The nature of the job' (*n*=32). The workload and general lack of time provided for veterinarians to consult was the most frequently highlighted barrier to implementation, and also included sub-themes related to lack of time to practice the techniques and a lack of staffing. One participant highlighted the difficulty in investigating the efficacy of stress reducing veterinary care and the barriers to implementation for the whole industry, as if emergency, specialist and GP clinics operate in the same way: "Clinical practice" is too broad a term. Emergency and routine general practice need to be examined individually. Examples being: a 2 minute wait or allowing an animal to approach is not possible in many emergency situations particularly in life threatening ones or when immediate analgesia is required.." (ID144). Another participant commented: "There shouldn't be any!" (ID182).

Table 6: Content-driven themes (and subthemes) of barriers to implementation of stress reducing veterinary care, in order of frequency of responses, with examples.

Theme/ Subtheme	Example quote/s	Number of responses
Theme 1: Workload (n=143)		
Workload and appointment time	"Lack of time is the major barrier for implementing desired fear free measures. Often, there is not enough time scheduled to allow animal to acclimate to the room, and to perform the exam slowly, backing off when the animal gets stressed to allow him to cool off before reinitiating. Longer appointments would allow this." (ID233) "Time pressures - overbooking consults & surgeries and rushing often equates to more physical force used with animals by staff" (ID189)	129
Time to practice/ Staffing	"Time to learn and implement" (ID292) "Some nurses are less inclined to use fear free techniques as they are "trying to get on with the day" (understandable sometimes as they can be very busy and overworked due to understaffing of nurses)"(ID213)	14
Theme 2: Workplace (n=78)		
Culture	"Old school thinking, unwillingness to change" (ID206) "all employees need to be on board and acknowledge when FF medication are needed - be consistent" (ID239) "also there are still some practitioners that don't see the importance of it." (ID29)	52
Management & Policy	"Management compliance and recognition that it is a very important step in providing gold standard care" (ID138) "THE MANAGER - does not care what we want to do in the clinic - it is about profit for her" (ID256) "More focus spent on time management and practicality of the environment rather than animal behaviour.More care is taken to minimise aggressive behaviour towards staff members." (ID321) "Still ensuring that correct OH&S procedures are in place so people dont get bitten." (ID29)	22

	“Being rushed by your boss.” (ID216)	
Personal	“Difficult to implement change when you are a casual employee” (ID67) “Compassion fatigue resulting in stresses staff” (ID71) “patience” (ID158)	4
Education (n=73)		
Colleague	“Poor education of veterinary industry staff to recognise fear and anxiety; sometimes dismissal of fear as aggression” (ID145) “Poor training of students in animal behaviour, welfare and fear-free practices (eg scruffing of cats is still taught to veterinary nurses as an acceptable method of restraint).” (ID189)	45
Client	“Clients don't genuinely understand the emotional cost and long term effects of causing [fear, anxiety or stress]” (ID103) “some owners do not think their animal is stressed and they are resistant to administering anxiolytics.” (ID233) “and many still believe in dominance theory, thinking we are weak if we spend the time with the pet.” (ID86) “Owners not understanding and being forceful/aggressive to their pets or myself” (ID326) “Poorly educated owners reinforcing anxious behaviour” (ID217)	15
Mis-perception of stress reducing veterinary care	“Perceived addition of time and cost” (ID146) “No perceived benefit Perceived time imposition” (ID278)	10
Personal barriers to education	“Costs involved in training - should be incorporated with University training before graduating” (ID259)	3
Resources (n=31)		
Building	“Space constraints in the waiting room.” (ID126) “Physical set up of the waiting room, prep area and hospital ward. Poor design of purpose built veterinary	30

	practices and limitations with buildings converted to veterinary practices.” (ID189)	
Cost	“Financial restrictions with client not allowing us to medicate fearful patients.” (ID131) “Price (Clinic does not wish to use Adaptil in house).” (ID258)	22
Other resources	“Having time and access to tools to implement this” (ID107) “development of pain free injection delivery systems” (ID202)	7
Clients (n=48)		
Attitudes	“Clients not bothering to bring toys,[…]” (ID9) “owner perception (not all owners want fear-free approach and think you're being ridiculous if you suggest to come back another day with anti-anxiety meds on board)” (ID312) “Unco-operative clients, client letting their dogs run free in waiting room” (ID170)	27
Expectations	“Many owners are still time poor - they want it done quickly, they often don't understand why we can't just manhandle the pet and just get the job done,. Many do not want to medicate their dog even if it is only short term.” (ID86)	12
Skills	“owners now foster and encourage (unintentionally perhaps) fear in their pets. These days so much more is done in practices to accommodate these pets and yet they are far worse than they ever were before.” (ID186) “owner compliance and animal handling skills” (ID270) “Dogs that haven’t received basic training from owners” (ID318)	7
Nature of the Job (n=32)		

Competing priorities	"Need for tx vs stress- sometimes tx is more important for the animal (try to be as quick as possible to allow the patient to move out of stressful environment quickly)" (ID3) "Unknown health status of animal prior to examination, so could be risky giving treats from the beginning." (ID126) "Health and safety - at end of day prioritise my safety over dogs fear" (ID178)	13
Practice Type/ Situation	"we are rushed to get through so many patients (and in my clinic because it's ER) time is usually something we don't have a lot of on our side" (ID137) "Being a specialist clinic, there are some tests that must be performed which are invasive and have to be 100% conscious. This limits the fear-free abilities in consult. Once diagnosed, most the other work can be performed in a fear free manor." (ID171) "we had a recent fire evacuation where some of the fear free training went out the window, for the safety of the pets and staff had to be moved quickly. All animals were safe but all staff and animals were stressed. Something to work on" (ID12)	11
Patient-specific	"Size of the patient." (ID129) "some dogs are anxious in consult regardless of what I do" (ID178)	8

5.4. Discussion

We aimed to investigate stress reducing certification, factors that predict attitudes to stress reducing veterinary care and to explore the barriers to implementation within the Australian veterinary industry. Australian veterinary professionals generally agreed that stress reducing veterinary care techniques are important within the industry, yet only one in five professionals surveyed held a stress reducing veterinary care certification and a similar number reported their clinic advertised as 'fear-free'.

Attitude to animals and fear free certification were associated with attitudes to fear free veterinary care. Participants with certifications were more likely to have more positive attitudes to reducing stress in the veterinary context. Higher AAS scores generally indicate a more positive animal welfare opinion. Taylor and Signal (2005) investigated attitudes toward animals in the Australian population and reported lower scores for males and females than those listed here; Australians that work within the veterinary industry have slightly more positive attitudes toward animal welfare in comparison to Australians in general. Further, while official Fear-Free™ clinic certifications are not currently available in Australia, the number of those advertising as stress reducing suggest it may be a service of interest to the Australian veterinary industry. However, Feilberg et al. (2021) found one participant (of 91) reported that their UK-practice was a 'fear-free' certified clinic. Both the value and interest of such clinic-wide certifications warrant further investigation. .

The participants' professional role (e.g. veterinarian, veterinary nurse) did not influence their attitudes to stress reducing veterinary care or their likelihood of having a certification. Feilberg et al. (2021), also reported no significant difference in perceived frequency of use of strategies based on 'demographic factors' (potentially including role within the clinic). Existing research tends to be veterinarian-centric in nature. Of those that specify, Lind et al. (2017) report good agreement between veterinarian and veterinary nurse observations of stress in the examination room, Arhant et al. (2019) compare the attitudes of veterinarians and veterinary students in Austria toward the feasibility and benefit to welfare of various strategies to reduce stress, and; Dawson et al. (2016) survey veterinarians, veterinarians with welfare expertise and welfare researchers to ascertain beliefs about practicality, feasibility and potential improvement of animal welfare in the veterinary context. Cat handling practices, as self-reported by 1,254 veterinary professionals in United States of America and Canada, differ significantly dependent on role within the clinic (Moody, Dewey & Niel. 2020). The authors report veterinarians are less likely to use minimal restraint than non-veterinarians during examinations, although the inverse was true during procedures. The impact various roles within the veterinary profession may play on the implementation of stress reducing veterinary care techniques or likelihood of certification requires further investigation.

Stress reducing veterinary care certifications may help predict veterinary professionals' attitudes to reducing stress in the veterinary context, and influence how often professionals implement, and their ability to implement, such techniques. Frequency of use of stress reducing veterinary care techniques is not well established, although Feilberg et al. (2021) suggest UK participants report relatively frequent (regularly/always) use of low stress handling techniques in waiting rooms, during examinations, in-patient care and overall practice ethos, and to a slightly lesser extent in patient wards, updating patient records and client education strategies. However, the impact a certification may have on the ability to implement stress reducing veterinary care in clinical practice warrants further investigation. That is, from the present study, does: 1) a certification increase the frequency of use of stress reducing practices? or; 2) having a certification highlight strategies already commonplace within a veterinary clinic that were previously not considered as stress-reducing?

Respondents provided free-text responses on strategies currently used to mitigate fear or stress during veterinary visits in clinical practice in Australia. Many strategies presented by respondents can also be found in peer reviews of pet-friendly practices (e.g. using food, minimal restraint, separating dogs and cats, using 'calming scents', early chemical or anxiolytic intervention; Lloyd, 2017; Moffat, 2008; Riemer et al., 2021). However, other commonly reported strategies in the present study (e.g. bringing buddy pets in, including multiple staff in consult, or ensuring the same veterinarian works with a patient to better facilitate a positive relationship) were not. Likewise, Feilberg et al. (2021), Riemer et al. (2021), Edwards, Smith, et al. (2019), and Lloyd (2017) also recommend learning about body language, which was not reported as being used currently by professionals in the present study, although staff education generally was highlighted by respondents as a barrier to implementation of stress reducing veterinary practice. Understanding species specific behaviour is a key factor in identifying fear and stress in companion animals (Lloyd, 2017; Overall, 2013), and staff education is highlighted by Dawson et al. (2016) as a major factor impacting animal welfare in the veterinary context. This discrepancy may be due to current veterinary professionals being aware of the necessity to understand body language, but not considering it as a technical strategy for mitigating fear or stress in the veterinary context. To date, the valuable contributions of Dawson et al. (2016) and Arhant et al. (2019) focus on the feasibility and practicality of improving welfare in the veterinary context in theory, from the perspective of various US/Canadian and Austrian veterinary industry stakeholders. Their work is reinforced by the content-driven themes in the present study regarding practices currently employed in clinical practice by Australian veterinary professionals (e.g. handling and interactions, clinic environment and appointment structure, use of food, pharmaceutical intervention and clients), and recent work in UK clinical practice by Feilberg et al. (2021). As such, continuing education in animal behaviour holds value for ameliorating stress or fear in the veterinary clinic, yet the feasibility and practical application of such strategies to reduce fear require further investigation.

Respondents in the survey report they use food distractions as a stress reducing approach, and food as reinforcers for good behaviour during veterinary visits. While some respondents highlight the risk for food prior to potential anaesthesia (e.g. the nature of the job, competing priorities), Westlund (2015) suggests the benefits outweigh the risks from a counter-conditioning and desensitisation perspective. Further, creative use of high value food can also mitigate risk (e.g. small containers of frozen chicken stock to lick (for example: VetsFirst.Riverport.VictorCentral (2021)). In fact, training behaviours for cooperative care within a veterinary context, may also provide the dog with a sense of control, predictability and autonomy, all of which are valuable in reducing behavioural and physiological signs of stress and are critical components of good animal welfare (Beerda et al., 1998; McGowan et al., 2014; Mellor, 2016). However, careful consideration for the correct order of learning and associative processes must be taken into account when employing food as a tool to mitigate stress (Howell & Feyrecilde, 2018; Riemer et al., 2021). For instance, using food as a distraction (e.g. a LickiMat® or Kong®) may be successful in some cases, but where the aversion to the handling or experience is significant enough, the food may become a predictor of aversive experience rather than an effective counter-conditioning tool. Anecdotally, many dogs refuse liver treats during veterinary visits and this may be due to the association made where liver treats are traditionally used to lure dogs into a position before an aversive (from the dog's perspective) event occurs. We suggest that veterinary professionals should consider the potential benefit of using food as a counterconditioning or reinforcement-based intervention, while keeping in mind the potential fallout for the wrong timing/delivery in some, more extreme fear cases.

Implementing stress reducing techniques holds its own challenges. Many of the free text comments regarding barriers to implementation of stress reducing veterinary care can be applied to aspects of the Theory of Planned Behaviour (TPB; (Ajzen, 1991), a phenomenon to help predict successful behaviour change in humans. TPB incorporates three foundations that influence the intent to change future behaviour: perceived behavioural control (their physical, financial and resource-supported ability to perform the behaviour); attitudes toward the behaviour, and; subjective norms (changing behaviour is less likely if those around an individual have poor attitudes toward the behaviour). Each of these predictors of successful behaviour change should be addressed within the veterinary industry framework (Edwards, Smith, et al., 2019).

From the present study, respondent attitudes toward the use of stress reducing veterinary care techniques were generally positive in nature. In contrast, individual veterinary professionals highlight negative subjective norms as a barrier to implementation. The ‘old fashioned’ attitudes of colleagues, ambivalence and mis-interpreting the impact of fear, anxiety or stress in their animals from guardians, and a lack of support from management can severely influence an individual’s ability to implement change.

Further, respondents reported that workload, the workplace, lack of education, and resources were barriers to implementation – all of which can relate to perceived behavioural control. Interestingly, perceived time constraints, clinic layout and environment and client compliance/ education were highlighted as significant barriers to improving animal welfare in veterinary practice (Arhant et al., 2019). Veterinarians also reported that time was a significant inhibiting factor in good communication skills with clients (Coe et al., 2007). Workload, work schedules, conflict with ethical and moral values and other employment conditions (e.g. requirements for maintaining registration – CEU points) are highlighted by Montoya et al. (2020) as factors contributing to their intention to leave clinical practice.

Respondents in the present study also emphasised aspects of the nature of the job (e.g. practice type, inherently anxious patients) as barriers that have not been identified in previous research. Several reported challenges to implementation due to some dogs being fearful ‘no matter what you did’. These types of patients may be candidates for pre-visit pharmaceutical intervention (if not contraindicated). In such situations, good client communication and education becomes vital. In other instances, the nature of the job (e.g. emergency practice) may be genuinely inhibiting mitigation of fear or stress during veterinary visits and future research investigating how stress reducing strategies can be equally effective in emergency, specialist and GP clinical practices is needed.

Respondents also reported others' perception of stress reducing veterinary care taking too long or costing too much as a barrier to implementation. Barletta and Raffe (2016) suggest pharmacologic restraint techniques may not only improve behavioural outcomes over time for dogs needing sedation due to undesirable behaviour during veterinary visits, but also have a cost benefit due to less staff being required in comparison to physical restraint. Otherwise, peer-reviewed evidence of cost/benefit analyses of implementation of such techniques are currently lacking, which may inhibit the uptake of stress reducing veterinary care.

Some participants report that the lack of training of dogs (e.g. "Dogs that haven't received basic training from owners" (ID318)) or guardians accidentally 'reinforcing fear' as another barrier. Veterinary professionals are a credible and valuable source of information for guardians (Roshier & McBride, 2013). Therefore, veterinary professionals should consider the type of training when making recommendations to guardians regarding basic manners or helping their dog cope during a veterinary visit. Training with the use of punishment to stop unwanted behaviour is associated with increased risk of behavioural or welfare fallout (Blackwell et al., 2008; Ziv, 2017) and it can have an impact on behaviour in the veterinary clinic (Stellato et al., 2021) who identified previous training with punishment, and the use of punishment for unwanted behaviour *within* the clinic, as a predictor (along with other demographic, personality and clinic factors) for dogs who show aggression in the veterinary clinic. In contrast, the use of positive reinforcement (offering something pleasant after a desired behaviour to increase the likelihood it will happen again) has not been associated with such fallout, and can also be used to great effect in the veterinary context (Howell &

Feyrecilde, 2018; Jones, 2018; Monaco-Torelli, 2018). Further - interacting with kindness and compassion will not exacerbate a dog's fear response during veterinary visits; the original observations of Skinner (1965) describe reinforcement as a process contingent on observable behaviour, rather than emotion. A lack of response to basic training may be a greater reflection of the extent of a dog's fear or stress in the veterinary context and, for dogs who would normally respond in other settings, could be taken as a sign of escalating arousal.

5.4.1. Limitations

The convenience sample may reflect a bias toward those veterinary professionals who are keenly interested in stress reducing practice. Further, as participants could be from the same practice, responses on the importance of stress reducing veterinary care, and strategies used in clinic could be skewed, and our results should not be extrapolated to the entire Australian veterinary professional population. Dawson et al. (2018) highlight the discrepancy between self-assessment of implementation of welfare strategies in the veterinary context and objective observation of interactions in reality. While questions in the survey were specific to their attitudes or provided clear examples of techniques to consider when responding about frequency, there is also a memory/ attention bias involved where participants are unlikely to remember every interaction or patient. While perception of implementation of stress reducing techniques does not equate to reality, the main aim of this investigation was to assess veterinary professional attitudes to reducing fear in the veterinary clinic. Further, due to the nature of our convenience sample the extent to which our results reflect the wider veterinary profession in Australia or internationally remains unknown. We note that only 10% of the variation in importance was explained by the model and this may reflect the measurement accuracy of the questions relating to veterinary professional beliefs about importance of stress reducing veterinary care. As such, our results should be interpreted with caution and the development of a validated scale investigating attitudes to welfare in the veterinary context, would provide valuable insight for the field.

5.5. Conclusion

Only one in five Australian veterinary professionals who participated in this survey hold a certification, despite most respondents generally agreeing it was an important aspect of veterinary care. Veterinary professionals were more likely to have positive attitudes to stress reducing veterinary care if they had a certificate and if they had more positive attitudes to animal welfare. Those with certifications were more likely to agree they had the clinical environment to implement stress reducing strategies in daily practice, and reported they used techniques to mitigate fear more frequently, than those without. Respondents offered many techniques currently used that can help inform the direction of future research into the efficacy of stress reducing veterinary care. However, respondents identified many barriers to implementation, of which the most frequently recurring related to the workload and lack of time inherent within the veterinary industry. We highlight that stress reducing veterinary care certifications may be useful, but improving welfare in the veterinary context is not as simple as 'holding a certification' without other changes occurring in veterinary workplaces. and industry structure.

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Chapter 6

General Discussion

6.1. Summary of findings

This thesis contributes to the discussion about the veterinary experience of companion dogs. Although it is well established in the literature that dogs find the experience of visiting the veterinarian stressful, little is understood about how and why that fear develops. This is an important issue given that routine veterinary care is integral to their health and welfare, guardians become distressed and may avoid care, and stressful dogs make accurate diagnosis difficult and pose a risk to veterinary staff. A dog's fear-response to the veterinary clinic also inhibits 'gold standard' veterinary care. Reducing distress and fear during veterinary visits is therefore not only integral for the continual improvement of welfare in the veterinary context, but also has wide-reaching impacts on client decisions and veterinary professional welfare.

Ultimately, this thesis complements the existing literature relating to stress reducing veterinary practice. Firstly, it demonstrates the significant benefits and challenges associated with research into physiological and behavioural measures of dog stress during a veterinary examination. While the challenges are indeed significant, it is clear that research and recommendations would be stronger if supported by evidence informed understandings about the fear-response. The second significant outcome of the thesis demonstrates wide-ranging implications for both future research and the ongoing development of stress reducing practice, for veterinary professionals, the companion animal industry as a whole, and the wider community who live with companion animals.

Chapter 1 reviewed what is already known of the dog's veterinary experience. Following previous reviews of mitigating fear in dogs during veterinary visits (Lloyd 2017; Moffat 2008), Chapter 1 provided a comprehensive overview of the factors that may influence a dog's perception of their veterinary visit, including a fearful response. Investigating the experience within a veterinary visit is complex, given the continuously changing environment, different sensory inputs, cumulative impact of previous experiences, human-animal interactions, interactions with other animals, experience of some form of pain or illness, and the prospect of being separated from their guardian. Building on previous reviews, Chapter 1 also emphasised the inherent responsibilities of each stakeholder of the veterinary visits (veterinary staff and clients) and highlighted strategies that could be used to mitigate fear or stress from different stakeholder perspectives; that is, what can veterinary staff *and* guardians do to help. Chapter 1 was novel in that it emphasised the difficulty with industry-wide implementation of such strategies through the lens of the Theory of Planned Behaviour (Ajzen 1991). These broad categories of influence in a dog's veterinary experience (genetic predisposition, current environment and potential previous experience, the type of handling, and the barriers and attitudes to implementing fear-reducing techniques by veterinary professionals in Australia) defined the nature of research within this thesis.

Current estimates of prevalence of fear or distress at the veterinary clinic vary greatly, with studies suggesting between 10% and 78% of dogs showing fear or stress in the veterinary context (Bragg et al. 2015; Csoltova et al. 2017; Doring et al. 2009; Engler & Bain 2017; Godbout et al. 2007; Hekman, Karas & Dreschel 2012; Hernander 2008; Kim et al. 2010; Lind et al. 2017; Mariti et al. 2017; Mills et al. 2006; Stanford 1981; Vaisanen et al. 2005; Volk et al. 2011). Considering this extreme variance, an initial aim of the research was to identify the prevalence of fear of the veterinary experience from a large sample. Chapter 2 demonstrated the extent to which dogs showed fear during a veterinary examination using a global sample of 26,555 guardian responses to the validated Canine Behaviour and Research Questionnaire (C-BARQ). Approximately 40% of guardians report their dog shows some form of fear (mild-extreme) when examined by a veterinarian, and 14% of dogs show severe or extreme fear (Edwards et al. 2019; Chapter 2). While guardian reporting has some limitations of memory, attention bias, and the ability to interpret their own dog's body language even after an educational intervention that improved behavioural observations of other dogs (Flint et al. 2018), questions within C-BARQ were validated (Hsu & Serpell 2003) and provided clear examples of what each type of fear looked like (e.g. moderate fear: "avoiding eye contact, avoidance of the feared object; crouching or cringing with tail lowered or tucked between the legs; whimpering or whining, freezing and shaking or trembling").

As behaviour is influenced by genetics and environment, a logical place to start in investigating factors that contribute to a dog's fear of their veterinary visits was the relationship between dog demographics and fear of the veterinarian. In the study described in Chapter 2, only 7% of the variation in fear observed during a veterinary examination (as reported by guardians) was caused by demographic factors tested: breed, source of acquisition, size, roles in the household, ages of other dogs, and guardian experience in owning a dog. That is, most of the fear observed when dogs are examined by a veterinarian is likely from extrinsic factors (e.g. the veterinary environment, the type of handling and interactions that are occurring, or previous experience and learning). The findings of Stellato et al. (2021) also reflect this: specific factors related to learning and previous experience are significant predictors of dogs that show fearful and aggressive behaviour within the veterinary clinic. These included: age of first nail trim, the use of positive punishment (applying an aversive consequence in an attempt to reduce the frequency of an undesirable behaviour) in training generally, and the use of positive punishment in response to undesirable behaviour *within* the veterinary clinic. In Chapter 2, the incorporation of genetic predisposition as a key factor of analysis contributes to established literature, which tended to focus on the current environment or interaction effects (Csoltova et al. 2017; Engler & Bain 2017; Lind et al. 2017; Stellato et al. 2019), and the influence of previous experience and demographic factors like dog sex (Doring et al. 2009). This global sample provided a unique perspective of the number of companion dogs experiencing fear within the veterinary context and some of the risk factors that predict it.

The findings from Chapter 2 suggested that fear of the veterinarian is largely a learnt response to the environment in the present, rather than innate or genetic in nature. As such, Chapter 3 developed a method to help identify when this learning might occur. Previous research had investigated a dog's veterinary experience within the clinic, meaning the environmental factors (e.g. the sights, sounds, smells, and slippery surfaces) and real-life interactions with others that could be confounding factors. While there is value in measuring experience in a realistic context, identifying the potential causes of the development of fear of the veterinary clinic also needs to break the veterinary experience down. With this in mind, the study in Chapter 3 investigated how healthy dogs reacted to a standardised physical examination in a constructed veterinary setting. In keeping with previous research (Csoltova et al. 2017), average heart rate (bpm) increased significantly in the consult room during the physical examination in comparison to the neutral waiting room. However, distinct from previous research, approximately one in three dogs had a heart rate peak over 180bpm during the physical examination (a sign of sinus tachycardia (Hackett 2015)), and a maximum recorded heart rate of 230bpm was observed. These heart rate measures are of significant concern as they may pose a risk to cardiovascular health if heart rate stays high for longer periods of time, or if these increases occur frequently.

Attempting to identify the catalyst of a fear response to a routine examination, steps of the physical examination were broken down and heart rate responses between each compared. The major outcome of Chapter 3 was that dogs vary greatly in their behavioural and physiological responses to a physical examination, at least, within the convenience sample used. Dog responses varied significantly according to which step they were undertaking during the examination, with the first step (Pats) and last step (Fake Vaccination) resulting in significantly higher heart rate than other steps. Our results also show that male dogs had a lower heart rate response, and supplement the findings of Doring et al. (2009), who report male dogs showed less behavioural signs of fear than female dogs in the clinic. The results of Chapter 3 contrast with findings by Ferasin, Ferasin and Little (2010), in which sex contributed to heart rate less than whether a dog was calm, excited, or nervous at a baseline measure before a clinical examination. Further, while most of the dogs in Chapter 3 were neutered, neuter status and other demographic factors were not significantly associated with heart rate responses in Chapter 3. This further reinforces our findings in Chapter 2 that neuter status and age of neuter were not significant predictors of the variation of fear observed by guardians in dogs undergoing a veterinary examination. The elevated heart rates observed in Chapter 3 may also be a concern during physical examinations, as heart rate measures taken by veterinarians may not be consistent with a dog's normal heart rate. Instead, other strategies such as taking multiple measures throughout or using a non-invasive heart rate recording device like the Polar H10 strap attached in the waiting room may give more accurate results.

As heart rate measures physiological arousal, but not affective state, the elevated heart rates observed could be due to positive emotions (e.g. excitement) or negative (e.g. fear or stress). In Chapter 3, behavioural signs of fear (tail tucked under stomach and ears positioned backwards) were significantly (moderately, positively) correlated with heart rate, indicating that increasing heart rate could be s a sign of a negative emotional state during the physical examination. The findings of Chapter 3 are reinforced by Stellato et al. (2019) who suggest that handling generally is of greater concern to dogs than the generic background noise of a veterinary clinic. In this study the examination occurred in a neutral environment, but environmental factors like the sensory input from the veterinary clinic, or interactions or handling experiences in the present, or previous experiences, may have a greater impact on a dog's experience, than demographic factors.

Compounding these concerns that the current environment and interactions largely impact fear responses within the veterinary context, is the simulated nature of the investigation in Chapter 3. The standardised physical examination was conducted by a veterinary nurse trained in low stress handling techniques and included simulated aspects of a physical examination (fake vaccination, fake temperature) and occurred within a mock veterinary setting. As such, the heart rate and behavioural responses reported in Chapter 3 are likely to be more extreme in a real examination, involving an actual injection, for instance. A final significant discovery was that the variation in heart rate was observed across steps of the examination, indicating that dogs may cope better or worse at some aspects than others. It may be that in some dogs with an increase in heart rate at a specific step (e.g. mock vaccination) that there had previously been a negative experience associated with vaccination. However, it is impossible to know all of the previous experiences of dogs, and fear of the veterinarian may not require a single defining aversive event, but instead result from the accumulation of a series of seemingly minor negative experiences.

Gaining a clear understanding of a dog's response to different aspects of the physical examination in Chapter 3 was difficult while accounting for inherent individual variation found in demographics, examination location, guardian feeding of treats, failures and behavioural indicators of fear or stress. In retrospect, while behavioural observations were integral, the way the study had been designed made analysis difficult. Future investigations into the effect of different steps of a physical examination on a dog's fear response could study one step at a time in a small sample size in order to break up the need to compare across steps, or may require a much larger sample size with a focus on only a few behaviours. While it may be slightly more invasive, a camera on the examiner and guardian (or a roaming videographer in addition to stationery camera points) may allow a better view of the dog at all times.

To build on the finding in Chapter 3 that an aspect of a routine veterinary visit may contribute to the development of fear of the veterinary context, Chapter 4 aimed to investigate a dog's responses to a routine care procedure that occurs both within and outside of a veterinary experience: a nail trim. Anecdotally, nail trims are often reported as a cause of stress and fear in companion dogs. They are a service offered by veterinarians, often because guardians have difficulty trimming their dog's nails. However, during preliminary research in designing this study, it became apparent that peer-reviewed research relating to nail trims in companion dogs is remarkably scarce. Thus, Chapter 4 became a novel contribution to the literature, providing valuable insight into a dog's nail trim experience and offering recommendations for future research. The same dogs from Chapter 3 (a convenience sample of 35 healthy, companion dogs) underwent a standardised nail trim procedure immediately after the physical examination. As with the physical examination, dog heart rate was significantly higher during the nail trim than in the waiting room, with one in five dogs having a heart rate peak above 180bpm (maximum observed 229bpm). While the prior physical examination may confound the results of the nail trim procedure, this is also a pattern of care that occurs during veterinary visits. Dog sex and stress behaviours were significant predictors of the variation in heart rate observed. Further, approximately half (45.7%) of dogs failed at least one step of the nail trim due to behavioural escalation to aggression or struggling excessively. Regarding previous experiences of nail trims and guardian routines around nail maintenance, approximately one third of guardians report their dog needed nail trims two to five times per year, just under one third report their dog never needed a nail trim, and nearly one third suggest their dog had experienced a painful nail trim in the past. This also provides evidence of guardians seeking support to trim their dog's nails from other animal care professionals (e.g. veterinarians and groomers), and the first indication that a guardian could not trim their dog's nails unless it was sedated.

The behavioural and physiological responses observed during nail trims indicate that trims are likely a stressful experience for dogs, but also may be more extreme in a real veterinary clinic, if more forceful restraint was used, or if multiple nails on each paw were cut consecutively (instead of one nail per paw as was done here). The guardians that participated in this study had a variable approach to nail trims for their dogs. While exploratory in nature, the outcome of Chapter 4 suggests nail trims may be a contributing factor to dogs developing fear of the veterinary clinic, either by 1) being an experience that occurs within the clinic, or 2) being an experience that occurs outside the clinic but contains handling and interaction experiences that inherently overlap with procedures that occur within the clinic. Chapter 4 highlighted several key areas for further investigation for nail trims in order to better our understanding of how nail maintenance may impact both a dog's veterinary experience, and their welfare generally.

One of the barriers to mitigating stress or fear of the veterinary clinic identified in the literature review from Chapter 1, was the ability for the profession to implement and adopt changes in clinical practice. While companion animal welfare in the veterinary context has been gaining traction in recent years, the attitudes of industry toward the implementation of stress reducing veterinary care techniques are not well established. To help address this gap, Chapter 5 investigated the attitudes and barriers to implementation of stress reducing veterinary care from a sample of Australian veterinary professionals (veterinarians, veterinary nurses and those in other roles like reception, practice management or kennel hands). These veterinary professionals generally felt stress reducing veterinary care was an important aspect of veterinary medicine, and approximately one in five respondents held a stress reducing veterinary care certification. Those with certifications reported higher frequency of use of stress reducing veterinary care techniques, and were more likely to agree they had the clinical environment to implement such practices than those without a certification. Feilberg, Corridan and Buckley (2021) recently published the self-reported frequency of use of specific stress reducing veterinary care techniques from a sample of 91 veterinarians and veterinary nurses in the UK, but to date, this is the first study to investigate attitudes and implementation in the Australian veterinary industry. While Scalia, Alberghina and Panzera (2017) report the benefit of low stress handling techniques (but not the official 'Low Stress Handling' certification) in a pilot study of eight dogs, proof of the efficacy of such certifications in changing veterinary professional behaviour to reduce companion animal stress within the clinic is lacking. This presents the first indication that attaining a certification may either: 1) influence the frequency and ability of veterinary professionals to mitigate stress in practice, or; 2) empowers veterinary professionals to *feel* as if it does. Industry adaptation to stress reducing techniques in practice should be considered within the Theory of Planned Behaviour (Azjen, 1991), and the efficacy of strategies to reduce stress and the value in holding a fear free certification are valuable avenues for future research.

The most commonly-reported barrier to implementation of the stress reducing veterinary care techniques identified in Chapter 5 was related to a lack of time (a potential aspect of perceived behavioural control). Veterinary professionals can have a high workload: short consult times, overbookings, walk-ins, and clients running late or voicing additional concerns at the last minute within consult. Other barriers reported were the attitudes of other colleagues and clients toward stress reducing veterinary care, and the perceived additional time required. It can be natural to emphasise the additional time that may be required to incorporate new processes, and easy to overlook how such processes may benefit in other ways. For instance, Barletta and Raffe (2016) recommend the use of chemical sedation for fractious dogs, as one of the benefits is to reduce the requirement for additional staff that would otherwise be involved in physical restraint. The use of pharmaceutical intervention to reduce stress is a strategy that was also reported by veterinary professionals in self-reported responses of stress reducing veterinary care techniques in Chapter 5.

While previous studies have assessed the feasibility or beneficial nature of implementing common strategies to reduce fear or stress within the veterinary context (Arhant, Hörschläger & Troxler 2019; Dawson et al. 2016; Gazzano et al. 2018), the qualitative research conducted in Chapter 5 offered the first opportunity for veterinary professionals to provide free text responses regarding stress-mitigation techniques used and the barriers to implementation. These responses showed that while, at present, literature in the field focuses on what can be done to reduce fear of the veterinary clinic, there are a multitude of challenges beyond veterinary professional control (e.g. support from clinic management or guardians, appointment length or over-booking, the nature of the job) that need to be addressed before stress reducing veterinary care can be incorporated into the industry as a gold-standard of care.

6.2. Directions for future research

6.2.1. Missing links when considering the fallout of fear of the veterinary clinic

In investigating the dog's experience of a veterinary visit, and strategies to reduce fear, the impact due to fractious animals appears well documented (Frank 2014; Fritschi et al. 2006; Jeyaretnam, Jones & Phillips 2000; McArthur & Fitzgerald 2013; Overall 2013; Shepherd 2009). However, one of the unreported downsides to fear of the veterinarian relates to guardians having to make decisions about quality of life outcomes in situations involving long term medical care. That is, do fearful dogs have poorer prognoses because they are fearful of the veterinary clinic and invasive or long-term care would impede their day-to-day quality of life? It has been established that guardians are reluctant to take their dog to the veterinary clinic unless the dog really needs it, or they will initially seek advice online (Volk et al. 2011). Yet the extent to which fear of the veterinarian impacts the type or quality of care that can be provided or recommended by veterinarians is unknown. In 2020 for example, I was forced to consider my dog's fear during veterinary visits as a significant influencing factor when choosing between treatment options for osteosarcoma. There are many chronic, painful, long term, congenital, or terminal diagnoses that occur for companion dogs, and guardians are required to make decisions on their care weighing up quality of life with or without veterinary treatment – a significant factor of which may include whether the delivery of treatment alone is worth the stress and fear for both the dog and guardian. Long term care is an integral component of companion dog welfare, and future research into how guardians of fearful dogs make decisions about veterinary care in chronic or terminal cases is vital to improve understanding of how the dog experience in the veterinary context impacts welfare.

Veterinary care practices and policies have been required to adapt in response to COVID-19 (Kogan et al. 2021), including conducting telehealth consults, or consults with the guardian remaining in the car while the dog is collected and brought into the veterinary clinic. These changes in the way veterinarians have practiced medicine during the pandemic may have unexpected outcomes in the reduction of fear of veterinary care. For instance, while a video phone consult may not be ideal in acute situations, they may have value in the provision and follow up of long term care for dogs fearful of attending the clinic. Conversely, Csoltova et al. (2017) and Stellato et al. (2020) highlight the value of guardian presence in reducing signs of fear during a physical examination. The nature of the pandemic may have been the catalyst for change in the way veterinary care is offered and provides a new field of research relating to the way veterinary practices consult in an attempt to mitigate fear or stress in the veterinary context.

Further to considerations for quality of life for long term care, Doring et al. (2009) reported dogs that had a negative experience during their last visit were more likely to show behavioural signs of fear during the current visit, even if it was positive in nature. Dogs are able to anticipate the pain next time (Overall, 2013). Along with the 'white coat effect' (Marino et al. 2011; Moesgaard et al. 2007), this would indicate that dogs' veterinary experience may be cumulative in nature. It is important to emphasise that this sort of experience (or perception of experience) is unlikely to change if nothing about the visit or handling experience changes; dogs will become increasingly sensitised to their veterinary visits if guardians or veterinary professionals are unable to break the cycle. For this reason, investigating strategies to reduce fear or stress during veterinary visits should be aimed at preventing cumulative fear experiences or mitigating their impact. Further, longitudinal studies would provide valuable data on experiences that result in an increase in stress or fear within the veterinary context, and practical strategies that have resulted in reduced stress or fear.

Another consideration for future research involves the extent to which guardian reluctance to attend veterinary visits because of a fearful dog may compound the issue of fear of the veterinarian. If guardians are hesitant to attend because their dog becomes extremely fearful or fractious, dogs may not be receiving adequate care until they are extremely unwell. Additionally, guardians seek veterinary advice online (Kogan, Hazel & Oxley 2019), the frequency of which may increase for guardians of dogs fearful of their veterinarians. Such advice may not always be accurate, relevant, or evidence-based. The extent to which having a dog fearful of the veterinary clinic impacts guardian decisions to attend, and how else they source veterinary medical advice, requires further investigation.

There is no definitive peer-reviewed list of behaviours that have been validated against physiological measures that indicate 'this' is what fear looks like in dogs. In practice, fear or stress is predominantly identified through behaviours. The difficulty here lies with the fact that behaviours can also be punished (frequency reduced) and reinforced (frequency increased) (Skinner 1965; Thorndike 1927) by conscious or inadvertent interactions with others. Well-intentioned guardians may punish a dog for growling, which will inhibit the dog's likelihood for growling in the future, but not address the underlying cause for the growl in the first place (Overall 2013; Shepherd 2009). This would be like removing the batteries from a smoke alarm – things might be fine until they are not, and a clear, obvious warning is valuable in reducing the risk of injury to veterinary professionals. Traditionally, researchers have not accounted for the potential suppression of warning or fear-signalling behaviours. Investigations into how companion dogs cope with aspects of their care or other lifestyle experiences should incorporate behaviours that indicate a positive and relaxed emotional state. Merely the lack of fear-related behaviours should not be a measure of success in interacting with the dog, but rather the presence of calm and relaxed behaviours. Dinwoodie, Zottola and Dodman (2021) highlight the potential value in using relaxation protocols (among other training processes) in behaviour modification generally. Identifying the extent to which behavioural indicators of fear or stress may change as a result of suppression of behaviour, and promoting calm and relaxation behaviours in dogs during routine care or other experiences, are valuable avenues for further investigation.

Lastly, fearful patients may have negative impact on veterinary professional mental and physical well being. The barriers to implementation highlighted in Chapter 5 (e.g. workload/ lack of time), mirror the findings of Montoya et al. (2020), who suggest work-related factors like 'lack of time' contribute (in conjunction with some personal factors) to veterinarians' intention to leave clinical practice. Stress reducing veterinary care may also be effective in reducing the risk of injury to veterinary staff. Veterinarians report injuries as a negative factor in their ability to derive pleasure in their work (Clise, Matthew, McArthur, 2020). Further, moral distress is a concern in veterinarians (Montoya et al. 2019) and the extent to which attempts to provide high quality, veterinary care to fearful or fractious animals, or in cases where clients or colleagues are unsupportive of such practices, impact veterinary professional moral distress warrants further research. While fear-free veterinary practice may have positive benefits for companion dog welfare, it may also have unexpected benefits in contributing positively to veterinary professional mental health and welfare too.

6.2.2. The intrinsic nature of a veterinary visit

In order to address fear of the veterinary clinic, researchers and veterinarians must first properly identify where the fear begins. This thesis has demonstrated that dogs may show a heightened physiological response during physical examination in comparison to baseline, and these responses may be fear-based as suggested in the outcomes reported in Chapter 3. In fact, dogs show more stress or fear responses in the consult room in comparison to being at home (Bragg et al. 2015), being examined at home (Soares et al. 2012), or a common treatment area (hospital area; Mandese et al. 2020). However, it is uncertain whether those increasingly intensive processes of a veterinary visit (e.g. home, waiting room, consult room, examination) are stressful in and of themselves, or whether they have been associated with the final trigger (the experience of the consult room) via classical conditioning (Howell & Feyrecilde 2018). These remain critical unanswered questions in the field. Does fear, for instance, build up with intensity via a trigger stacking effect (an accumulating physiological fear response) as suggested in Chapter 1, or does a strong emotional reaction to an experience in the consult room become associated with the immediately preceding steps? A greater understanding of the catalyst of fear, and how those different steps interact and influence each other, may assist in developing an intervention that is more effective in preventing negative experience in the first place.

The failure rates in both Chapter 3 and Chapter 4 for the standardised physical examination and the nail trim procedure are of particular interest. In these studies, a step in the physical examination or nail trim was coded as a 'fail' if the dog struggled excessively, or if the dog's behaviour was escalating to aggression. Chapters 3 and 4 suggest components of routine veterinary care are considerably stressful for healthy companion dogs, and previous literature supports this relating to the veterinary experience. While Stanford (1981) notes that a proportion of dogs refuse to enter the veterinary clinic, the reality is that in many cases a dog is required to complete the examination, or nail trim. This is especially the case in situations where a guardian has purchased a service from an animal care professional (e.g. a veterinarian or groomer) or is seeking medical advice from a veterinary professional. The failure rates seen within the research context—mock veterinary setting with an examiner trained in low stress handling —are likely to be much more extreme in a real-world setting. For instance, where guardians are trimming their own dogs' nails, this poses a risk of injury to guardians who may not have the relevant training and experience in identifying body language and responding appropriately. Chapters 3 and 4 provide unique contributions to the field in that a large proportion of dogs may not complete a physical examination or nail trim unless forced.

The Fear-Free Veterinary Professional certification highlights the value of assessing 'needs vs. wants' in veterinary medical triage (FearFree 2016), whereby medical intervention that is absolutely necessary for the immediate welfare of the patient continues in as low stress manner as possible. However, in all other non-emergency cases, clients can be encouraged to reschedule with a training plan and potential pre-visit pharmaceuticals to assist in reducing fear, or a non-critical aspect of a physical examination may be withheld. These discussions would be valuable for all animal care professionals to consider, as animal advocates and client advisors. In this case, future research should focus on: 1) the prevalence of 'failures' in common components of companion animal care and the extent to which missing non-critical steps or rescheduling may impact welfare in the veterinary context, and 2) the impact of current handling practices (e.g. ceasing an interaction if a dog is struggling excessively, or forceful completion of an examination) on responses in future visits.

6.2.3. Taking a more holistic perspective

Understanding all aspects of fear of the veterinary clinic in companion dogs is incredibly complex. With the exception of Stellato et al. (2021) who used an online survey to identify factors that were associated with fear at the veterinary clinic, research currently focuses on dog behaviour and physiological responses within the veterinary clinic, or within a veterinary context (e.g. a standardised physical examination in a neutral room –Csoltova et al. (2017); Chapter 3). Where Doring et al. (2009) report that previous negative experience influences the dog's responses in the current visit, the assumption is still negative experience within the context of a veterinary visit. However, companion dogs live potentially stressful lives outside of the veterinary clinic, especially in urban settings (Silva & Fontes 2019), and experiences outside the veterinary context must also be taken into account. For instance, Stellato et al. (2021) identified the use of positive punishment training methods in general (at home/ in training classes) as a significant predicting factor for fear or aggression during veterinary visits. This is in keeping with other findings assessing the associations between aversive training techniques in dogs and the presence of problem behaviours, stress, aggression, or reduced guardian satisfaction (Blackwell et al. 2008; Kwan & Bain 2013; Schilder & van der Borg 2004; Ziv 2017). Stellato et al. (2021) also found that dogs that received their first nail trim at an older age were more likely to be display aggression (as reported by their guardians) within the veterinary clinic. While nail trims can occur outside the veterinary context, Chapter 4 highlights at least some guardians do seek veterinary assistance in completing them, and that they are likely a stressful experience.

Stressful nail trims become a cause for concern as the extent to which other handling or interactive experiences at home or when out and about can impact a dog's behaviour in the veterinary clinic is unknown. Dogs get pats from strangers, go to groomers, attend basic training classes, get washed and brushed at home, or at the groomer, and stay with pet sitters or boarding facilities. There is remarkably little peer-reviewed literature available to aid in our understanding of the impact of these interactions on dog welfare. The previous experience and learning that takes place during these situations external to a veterinary clinic may also impact how a dog responds the next time they are in a similar situation. Further, potential stressors that occur on the day of the visit require consideration. Dogs may dislike having harnesses or collars placed over their head, or car rides. These 'day-of' triggers may accumulate to increase the likelihood of an extreme stress response on the day of their veterinary visit (as argued in Chapter 1). The extent to which such extrinsic factors are confounding current research on dog experience in the veterinary context is unknown. This limits research investigating dog responses to veterinary care, because dogs do not behave or learn in an isolated vacuum; their experience is cumulative, and research into mitigating fear in the veterinary context will benefit from a more holistic approach that acknowledges the whole life and experience of a companion dog.

6.2.4. The efficacy of stress mitigating strategies

A lack of peer-reviewed evidence of individual strategies or the overall ethos of the 'fear-free' movement may contribute to veterinary professionals' or guardians' hesitance to adopt a new approach to veterinary care. Chapter 5 illustrated the variation in strategies used in practice by veterinary professionals to mitigate fear or stress. Many of these, such as minimal restraint or the use of food in some capacity, are summarised by stakeholder responsibility in Chapter 1 (Edwards et al. 2019) and recommended in reviews and grey literature (Arhant, Hörschläger & Troxler 2019; Bain 2020; Becker et al. 2018; Dawson et al. 2016, 2018; Herron 2015; Howell &

Feyrecilde 2018; Jones 2018; Lloyd 2017; Moffat 2008; Overall 2013; Riemer et al. 2021; Yin 2009). However, evidence of the efficacy of such strategies remains lacking. From the peer-reviewed literature, guardians interacting with their dog positively during a physical examination can reduce stress (Csoltova et al. 2017), the efficacy of synthetic dog appeasing pheromones remains contentious (Frank, Beauchamp & Palestrini, 2010; Mills et al. 2006), classical music aids guardian satisfaction with the consult, although has no significant effect on the dog (Engler & Bain 2017), and examining a dog on the floor instead of the table resulted in less behavioural signs of fear (Doring et al. 2009). Many recommendations currently involve the use of food as either a distraction, or reinforcer for appropriate behaviour. While the peer-reviewed evidence of the efficacy of these strategies within the veterinary context is currently inadequate, these principles of behaviour change are well established in other contexts (Chance 2009; Skinner 1965; Thorndike 1927). The complexities relating to the use of food in a veterinary context are discussed more comprehensively in Chapter 5.

Pharmaceutical intervention (pre-visit pharmaceuticals and chemical sedation) were also highlighted as a strategy by veterinary professionals in Chapter 5. Dogs that become fearful or fractious enough to require additional restraint, may require chemical sedation and/or short-term anxiolytics (Riemer et al. 2021). However, if a patient is in a heightened state of arousal at onset of chemical intervention, the efficacy of such intervention is limited. Barletta and Raffe (2016) suggest chemical sedation is of greater benefit than physical restraint due to the reduced risk of injury to staff and fewer staff required, but they also observed positive trends in reduced behavioural responses of fear in dogs during consecutive visits. Similar findings regarding the efficacy of chemical sedation have been reported elsewhere (Hauser et al. 2020; Korpivaara et al. 2021). Additionally, Gilbert-Gregory et al. (2016) identified reduced behavioural signs of fear in dogs treated with trazodone as a short-term anxiolytic medication in hospitalised dogs. In contrast, Gruen et al. (2017) identified no significant effect of trazodone in comparison to a placebo, but suggest their trial design or outcome measures may have been confounding factors and their results should be interpreted with caution. While more research is required, it may be that chemical sedation offers a valuable opportunity to break the cycle of perpetual negative experience (if or once it starts). Of course, there will be situations where sedation is contraindicated or not possible due to the nature of the examination required (e.g. specialist or emergent practice as reported by veterinary professionals in Chapter 5). While behavioural interventions may help long term, there is a moral obligation to help animals in our care feel safe, and reduce risk of injury to others as quickly (and humanely and ethically) as possible. If anxiolytic medication can assist with this, and it is not contraindicated, there may be little harm in throwing it into the proverbial 'fear-free toolkit' to use as required. As with the recommendations of Sherman and Mills (2008) for anxieties and noise phobias, a structured approach to reducing fear of the veterinary clinic is required that includes plans for immediate mitigation of emotional distress (e.g. potential pharmaceutical intervention or careful environmental management), and long term strategy incorporating training and behaviour modification plans with counter-conditioning and desensitisation protocols. The implementation of strategies to reduce fear and distress may be critical in breaking the cycle of negative experience, yet a greater evidence base of their efficacy within the veterinary context is needed to foster longer term change.

6.2.5. Evoking industry-wide change

Chapter 5 demonstrated that many veterinary professionals felt implementing stress reducing veterinary care strategies in practice was inhibited by the nature of the work they do. This incorporated comments both relating to the patient characteristics (e.g. some dogs are stressed regardless, or health and safety as a priority), as well as the consideration that some examinations are invasive and require the patient to be conscious, or the difficult nature of emergency work. It stands to reason that some instances of veterinary care will be stressful and elicit fear responses in dogs regardless of what is done by guardians and veterinary professionals. However, further investigation into exactly what these instances are would be valuable. Developing a list of clinical interactions with dogs rated in order of 'least' to 'most' likely fear inducing based on research as well as veterinary professional consensus would be an invaluable learning tool for graduate veterinarians. Where is the line of 'acceptable fear' drawn and how can veterinarians and guardians be supported in negotiating it?

Investigating companion animal welfare in the veterinary context is difficult. Most often, researchers are not veterinarians or veterinary nurses, observing practice in real time poses difficult ethical concerns, and while responses to online surveys can be valuable, they are not a substitute for direct observation (Dawson et al. 2018). In order to build on the current literature regarding feasibility of strategies to reduce stress and overall impact on welfare (Arhant, Hörschläger & Troxler 2019; Dawson et al. 2016), Chapter 5 provides the first free-text responses on veterinary professional-reported techniques to mitigate fear, and barriers to implementation.

Increasing animal welfare in the veterinary context is multifaceted, and simply researching the efficacy of strategies to reduce fear or stress in specific situations does not provide the whole picture. Future research must also focus on veterinary professional capacity to implement these strategies in daily practice. Recommendations and guidelines that incorporate conscious, proactive and management-supported strategies are needed to reduce fear across every facet of a dog's veterinary experience. The qualitative research conducted in Chapter 5 identifies where techniques veterinary professionals currently use in daily practice overlap with recommendations (Lloyd 2017; Moffat 2008), but also provides insight into those that do not. For instance, understanding animal behaviour and body language are regularly recommended (Lloyd 2017; Moffat 2008; Overall 2013; Riemer et al. 2021; Shepherd 2009) in order to be able to respond appropriately during an interaction or physical examination, but veterinary professionals did not highlight that as a current or useful strategy. These points of disconnect are therefore critical to developing sustainable and effective fear-free practices.

Where Arhant, Hörschläger and Troxler (2019) and Dawson et al. (2016) report on the feasibility of methods to improve welfare in the veterinary context, emergent themes from respondents surveyed in Chapter 5 did not solely focus on feasibility. Veterinary professionals in Australia reported the common barriers to implementation were a 'lack of time' (which could potentially be inferred as an aspect of 'feasibility'), and challenges with colleague opinions (e.g. 'old fashioned vets'). Reducing fear in patients is critical to the veterinary and veterinary nurse duty of care (Heath & Wilson 2014), and while certifications may assist in implementation of stress reduction strategies, industry-wide and workplace change is needed for best effect. Recommendations for stress reducing veterinary care must consider that while some changes may be achievable for individual veterinarians or practices, others will require cultural change within the industry (e.g. changing attitudes of 'old fashioned' vets, greater evidence of benefit, including actual time taken to implement fear-free strategies) or the support of industry bodies that implement codes of practice (e.g. appointment duration, assessing needs vs. wants). Gaining a greater understanding of the interactions between welfare and well-being of companion animals, guardians and veterinary professionals, and the financial and institutional constraints of the industry will be invaluable in removing potential barriers to implementation of stress reducing veterinary care techniques in daily practice.

6.2.6. Reducing fear of care and handling 'takes a village'

The findings of Chapters 1, 4 and 5 suggest that researchers or industry professionals looking to mitigate fear responses within the veterinary context may need to consider other stakeholders. As highlighted in Chapter 1, both veterinary professionals and clients (guardians) are significantly impacted by dogs becoming fearful of their veterinary care, and are responsible for contributing to reducing that fear. For instance, if a guardian presents with a breed of dog susceptible to eye, ear or teeth problems that require recurrent treatment, veterinary staff can recommend training at home and socialisation visits in the clinic as valuable opportunities to practice those procedures with the dog prior to any negative or painful experience occurring. While the impact of repetitious veterinary care on the likelihood of a fear response in the future is unknown, it is logical to predict recurrent (potentially painful) experiences for dogs with constant health issues will result in escalating negative experiences. Chapter 4 found that guardians seek assistance from other animal care professionals for their dog's nail trims. The extent to which guardians struggle to implement care at home for other common health concerns (e.g. courses of antibiotics, allergy or pain medications) is also unknown.

Veterinary practices and guardians can team up with experienced dog trainers using positive reinforcement methods to teach cooperative care techniques (training behaviours that teach dogs to participate in their own healthcare). For instance, teaching a dog to remain still, or to present specific body parts on cue, push into an injection, being comfortable with gentle restraint or choosing to opt-in to starting a particular procedure (FearFree 2016; Howell & Feyrecilde 2018; Jones 2018; KarenPryorAcademy 2017; Monaco-Torelli 2018). Such training exercises can (and should) be incorporated into basic manners training classes, and puppy pre-school curriculums (as well as veterinary and veterinary nurse curriculums), and provide a level of control over outcomes and predictability that are invaluable in improving welfare outcomes (Beerda et al. 1998; McGowan et al. 2014). Other animal care professionals can also take greater responsibility in reducing fear during handling interactions - groomers can access a Fear-Free Grooming certification (FearFree 2016). In contrast, veterinary professionals may take every step to improve their fear-free and low stress handling techniques in practice, but if negative experiences of handling continue in the home or outside the clinic, the efficacy of such efforts will be reduced.

6.3. Conclusion

Veterinary care is integral to companion dog welfare. Many dogs experience fear or stress during their veterinary visits, which can have significant negative side effects for both their short- and long-term welfare, and the welfare of the staff involved. A veterinary professional's 'stress reducing toolkit' should include both long-term training and management plans to reduce fear and stress, and short-term chemical interventions to interrupt negative experience in the current visit. Addressing companion dog welfare in the veterinary context will require a collaborative effort and engagement of veterinary professionals and guardians, but other companion animal professionals must also be involved in the discussion. Of greater importance is ensuring that veterinary professionals have the capability to implement such strategies in clinical practice, and collaboration between veterinary associations, practice management and veterinary professionals is required to address this concern. Fear of the veterinary clinic has a significant impact on the welfare of companion dogs around the world, and every reasonable effort should be taken by veterinary staff, guardians and other animal care professionals to reduce or prevent aversive experiences at every interaction. This thesis highlights the complexity surrounding a dog's veterinary experience and emphasises the importance of further research for the continual improvement of companion animal welfare in the veterinary context. The quality of life for animals in our care is directly related to the quality of care provided to them by all involved.

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Appendices

Appendix 1: Chapter 3 & 4 Initial Participant Survey to Register Interest

Research background and ethics

Thank you for your interest in this research project!

What is the project about?

Lots of dogs become fearful or stressed during their veterinary visits. This research project aims to identify the most obvious trigger(s) that cause a fear response in dogs during a veterinary exam or nail trim procedure. By identifying these triggers (ie. Handling/ restraint, being put on the table, or the procedure specifics – nail clippers or stethoscope) you and your vet will be better equipped to prevent that fear from occurring at all, or potentially reduce how severe it becomes during veterinary visits.

Who is undertaking the project?

This project is being conducted by Dr Susan Hazel, Ms Petra Edwards, Dr Michelle McArthur and Dr Bradley Smith. This research will form the basis for Petra's PhD degree at the University of Adelaide under the supervision of the investigators listed above.

Why are you being invited to participate?

Participants in this study need to be 18 years old or over, and have a healthy dog (e.g. no conditions that may cause pain), that has attended the veterinary clinic within the last year. All dogs are welcome. You are being invited to participate if you have a dog that is calm and confident or happy to attend the veterinary clinic, or a dog that is scared (but not aggressive) of the vet, and meet the above criteria. Please note that, due to the nature of this research, and participant and researcher safety, we can only accept dogs that do not have a history of aggression in a veterinary context. We are also unable to accept dogs that require chemical intervention for veterinary visits (ie. Anxiolytics), but can take participants whose dogs are on a general daily medication.

What am I being invited to do?

If you consent, you will be participating in:

- This short online survey initially (expected 2min) to provide your contact details
- You will then be sent an email with a testing day and time to attend
- Upon arrival, we will attach a heart rate monitor strap around your dog's chest. We will need to apply some Ultrasound gel to get a consistent heart rate measurement from your dog. We will wipe this off at the end of the session.
- A wait period of approximately 30-60minutes in a 'waiting room' where your dog is given a chance to relax again after the heart rate monitor is attached. During this time you will have access to refreshments, and be asked to complete an online survey on the iPad provided which will give us more detail on your dog's veterinary history, health, behaviour and also some background on yourself.
- Once your dog is settled, we will invite you into the 'consult' room, where your dog will undergo a 'standard' veterinary physical exam (without temperature check), and have it's nails clipped. The researchers will be watching your dog closely for their behaviour and indicators of fear or distress. If at any stage your dog appears to become distressed, attempts to escape, or shows behavioural signs of escalation the procedure will be stopped and the next step started. You will be able to withdraw your participation at any time. You will be asked to interact with your dog however you normally would during a veterinary visit.
- You and your dog will be video taped from arrival to departure. While the main focus of video will be your dog's behaviour, you will also be captured in the recording as well.
- The testing locations are either: CQU Appleton Institute, 44 Greenhill Road, Wayville SA 5034 OR Adelaide University, Roseworthy Campus, Mudla Wirra Road, Roseworthy SA 5371

How much time will my involvement in the project take?

The initial online survey where you provide consent and contact details shouldn't take more than 5 minutes of your time.

What are the potential benefits of the research project?

By identifying the most salient causes of fear for dogs in a veterinary context, researchers aim to develop training or management interventions that may help prevent that fear in other dogs, or reduce the fear if it does occur. It will also provide you specifically with more information on how your dog experiences these veterinary visits and which areas are most stressful for your dog.

Participants will also receive a small gift of dog treats or a dog chew in thanks for their time, and will go into the draw to win one of two $50 PetBarn gift vouchers.

Can I withdraw from the project?

Participation in this project is completely voluntary. If you agree to participate, you can withdraw from the study at any time.

What will happen to my information?

Confidentiality and privacy: From the survey responses, your name will be coded so that your information will be de-identified. The video recordings will not be made available to the general public, but some photographs or video clips may be used to help share the results of the project via publication in scientific journals or at conferences. You will be given an option when you provide consent to participate in the study as to whether photographs/ videos that show you and/or your dog can be used when disseminating our findings.

Storage: During testing and data analysis, the information collected (survey responses and video recordings) will be kept on an external hard drive. When not being used, the hard drive will be stored securely at the University of Adelaide. Once completed, the data collected is required to be kept by the University of Adelaide for 5 years.

Publishing: The data collected and analysed will be published as part of the researcher's PhD thesis and as part of publication in a scientific journal. Neither your name or your dog's name will be used in publication. However, as mentioned above, photos may be used in publication if you provide consent to do so.

Sharing: If you indicate in the survey that you are interested in learning the outcome of this study, a summary of the results will be provided to you via email upon completion of data analysis, and a copy of the journal article will be emailed once published.

Your information will only be used as described in this participant information sheet and it will only be disclosed according to the consent provided, except as required by law.

Who do I contact if I have questions about the project?

Dr Susan Hazel
Susan.hazel@adelaide.edu.au
Phone: (08) 8521 2829
Ms Petra Edwards
Petra.edwards@adelaide.edu.au
Phone: (08) 8313 7681

Owner Consent

1. I have read the previous Information Sheet and agree to take part in the following research project: 'Identification of the trigger initiating fear during physical exams and nail trims'
Human Ethics Approval Number: H-2019-014
I understand that with this consent to participate, I will be contacted via email or phone by the researchers to provide further details of the study.
I understand that I can withdraw from the study at any time.

- ◯ Yes
- ◯ No

Contact details

In the following questions you will provide us with your contact details so we can get in touch with a testing day and location.

2. Full Name (First Last)

3. Phone Number

4. Email address (please ensure your email is entered correctly)

5. Suburb & Postcode

Eligibility to participate

The following questions give us more information about you and your dog to ensure you're the right fit for this study

6. I am the owner of the dog that will participate in the study

- ◯ Yes
- ◯ No

7. I speak and understand English fluently

- ◯ Yes
- ◯ No

8. I am sufficiently mobile to move from the car into and around the testing area (an office or teaching location with minimal stairs)

- ◯ Yes
- ◯ No

9. I am able to hold my dog on lead for up to 2 hours

- ◯ Yes
- ◯ No

10. Dog Name

____

11. Are your dog's vaccinations up to date?

- ◯ Yes
- ◯ No

12. Please upload your proof of your dog's most recent vaccination

You can also do this via email when we contact you, but proof of vaccination is required before participating in the trial

Choose File   No file chosen

Your dog's veterinary experience

The following questions are about how your dog experiences their average veterinary visits

13. Please indicate how fearful or stressed your dog becomes in the veterinary clinic

- ◯ **1. No stress/ fear**
  (Calm, relaxed and seemingly unmoved, or friendly, outgoing and seeks attention)
- ◯ **2. Minor stress/ fear**
  (Alert, but calm and cooperative)
- ◯ **3. Moderate Stress/ fear**
  (Tense, but cooperative, panting slowly, not very relaxed, easily led on lead)
- ◯ **4. Severe Stress/ Fear**
  (Obviously very tense, anxious, shaking, whining, will not sit/ lie down, panting intensely, difficult to manoeuvre on lead)
- ◯ **5. Extreme Stress/ Fear**
  (Extremely stressed, barking/ howling, tries to hide, needs to be lifted up or to be firmly forced when pulled by the lead)

14. When being examined by the veterinarian in the consult room, does your dog ever:

- ☐ Lunge
- ☐ Snap
- ☐ Growl
- ☐ Bite
- ☐ Show their teeth

15. Does your dog currently need short term anxiolytic (anxiety) medication to attend the veterinarian? (Ie. Do you need to give your dog some medication before the veterinary visit to help them cope?)

- ◯ Yes
- ◯ No

16. Is your dog on any other long term medications?

- ◯ Yes
- ◯ No

If yes, please specify the medication and what it is for:

____

17. Has your dog had a veterinary check in the last year?

- ◯ Yes
- ◯ No

18. Does your dog have any condition or injury that is likely to cause pain (eg. arthritis or muscle sprain) or any current illness.

- ○ Yes
- ○ No

If yes, please specify

19. Lastly, please indicate the testing locations and days that will be most convenient for you (please tick all that apply):

- ☐ Any location, any day/time
- ☐ Adelaide University, Roseworthy Campus, Mudla Wirra Road, Roseworthy SA 5371
- ☐ CQU Appleton Institute, 44 Greenhill Road, Wayville SA 5034
- ☐ April weekends
- ☐ Please specify any other days that you are available and we will do our best to suit you
- ☐ May weekends
- ☐ Morning
- ☐ Afternoon

Thank you for your time in completing this survey and consenting to participate in this research.
You will receive an email from one of the researchers within a week of submitting this survey. In the meantime, please feel free to contact Dr Susan Hazel (email: Susan.hazel@adelaide.edu.au) or Petra Edwards (PhD candidate) (email: petra.edwards@adelaide.edu.au) with any questions or concerns, or to withdraw from the study.
Your time is valued and greatly appreciated.

Appendix 2: Chapter 3 & 4 Participant Survey

Contact details

In the following questions you will provide us with your contact details so we can get in touch with a testing day and location.

1. Full Name (First Last)

2. Phone Number

3. Email address (please ensure your email is entered correctly)

4. Suburb & Postcode

5. Dog's Name

6. Age

Months

Years

7. Breed

(Please type the formal breed name. If a cross breed or your dog's breed is unknown, please type: 'Mixed Breed'

8. Gender

- ◯ Male
- ◯ Female

9. Weight (kg)

10. Where did you acquire this dog?

- ◯ Breeder/ Dog show
- ◯ Pet store
- ◯ Rescue/ Shelter (including website)
- ◯ Stray
- ◯ Friend/Family
- ◯ Online (Gumtree)
- ◯ Other (please specify)
- ◯ Online (Dogzonline)
- ◯ Online (Trading Post)
- ◯ Online (Other)
- ◯ Gift
- ◯ Newspaper

11. Has this dog been spayed or neutered?

- ◯ Yes
- ◯ No

12. If yes, at what age was this dog neutered?

Weeks

Months

Years

13. Is (or was) this dog employed in any of the following activities or roles?

- [ ] Breeding/showing
- [ ] Working roles
- [ ] Field trials/ hunting
- [ ] None
- [ ] Other sports

14. Is this the first dog you have ever owned?

- ○ Yes
- ○ No

15. Are there other dogs in your household?

- ○ Yes
- ○ No

16. If yes, are they also fearful of the vet?

- ○ Yes, at least one is
- ○ No

17. Do you take all your dogs to the vet at the same time for planned, routine checks?

- ○ Yes
- ○ No

Your dog's training history

The following questions are about the training you have done with the dog with you today

18. Please indicate any previous training your dog has done

- [ ] Puppy preschool
- [ ] Basic manners training
- [ ] Advanced skills or trick training
- [ ] Dog sports (e.g. agility, tracking, nosework, flyball)
- [ ] Other (please specify)

19. Please indicate the training methods you used

- [ ] Positive reinforcement: increasing how often a desired behaviour occurs in the future by rewarding it (e.g. praise, food treats, toys, patting or play)
- [ ] Negative reinforcement: increasing how often a desired behaviour occurs in the future by removing something the dog doesn't like (e.g. time outs, releasing physical restraint from holding the dog still or pushing it into position)
- [ ] Punishment: decreasing how often an undesired behaviour occurs in the future by doing something the dog doesn't like (e.g. telling the dog off, spraying water or physical corrections like smacks, scruffing or shaking)

20. Please indicate the most common training method you have used to teach your dog to be well-behaved during a routine/annual veterinary visit?

- ○ Positive reinforcement: increasing how often a desired behaviour occurs in the future by rewarding it (e.g. praise, food treats, toys, patting or play)
- ○ Negative reinforcement: increasing how often a desired behaviour occurs in the future by removing something the dog doesn't like (e.g. time outs, releasing physical restraint from holding the dog still or pushing it into position)
- ○ Punishment: decreasing how often an undesired behaviour occurs in the future by doing something the dog doesn't like (e.g. telling the dog off, spraying water or physical corrections like smacks, scruffing or shaking)
- ○ Not applicable

About your dog's veterinary visits

The following questions are about how the dog with you today has experienced their veterinary visits in the past

21. How often in an average year do you take your dog to the veterinary clinic?

- ◯ Less than once per year
- ◯ 1 to 2 times per year
- ◯ 3 to 5 times per year
- ◯ Over 5 times per year

22. Please indicate the reasons why you take your dog to the veterinary clinic

- ◯ Emergencies only
- ◯ Annual check up & vaccinations only
- ◯ Emergencies and annual check ups/ vaccinations
- ◯ Visits specifically to ask questions about my dog's health
- ◯ Visits specifically to ask questions about my dog's behaviour
- ◯ Visits specifically to ask questions about my dog's nutrition, grooming, etc.
- ◯ If my dog is obviously ill or injured
- ◯ If I think my dog might be ill or injured
- ◯ Other (please specify)

23. Please indicate how fearful or stressed your dog becomes in the veterinary clinic

- ◯ 1. No Stress/ fear
(Calm, relaxed and seemingly unmoved, or friendly, outgoing and seeks attention)
- ◯ 2. Minor stress/ fear
(Alert, but calm and cooperative)
- ◯ 3. Moderate stress/ fear
(Tense, but cooperative, panting slowly, not very relaxed, easily led on lead)
- ◯ 4. Severe stress/ fear
(Obviously very tense, anxious, shaking, whining, will not sit/ lie down, panting intensely, difficult to manoeuvre on lead)
- ◯ 5. Extreme stress/ fear
(Extremely stressed, barking/ howling, tries to hide, needs to be lifted up or to be firmly forced when pulled by the lead)

24. Do you avoid attending the vet for non-life threatening conditions (e.g. routine checks, nutrition or medical questions, grass seeds/ ear infections) because your dog is fearful at the clinic?

- ◯ Yes
- ◯ No

If yes, please briefly explain in which instances you will choose to attend.

25. Do you use any complementary therapies to help your dog cope during veterinary visits? (e.g. Thundershirts, adaptil sprays/ collars, aromatherapy/ essential oils etc.)?

◯ Yes

◯ No

26. Do you do or use anything else to reduce the stress or fear of your dog? If so, what?

27. In general, please indicate your dog's response to different aspects of their <u>most recent</u> veterinary visit:

	Calm, relaxed and seemingly unmoved (Or friendly, outgoing, seeking attention)	Alert, but calm and cooperative	Tensed by cooperative, panting slowly, not very relaxed, easily led on lead	Very tense, shaking, whining, will not settle down, panting heavily, difficult to manoeuvre on lead	Extremely stressed, barking/howling, tries to hide/ escape, needs to be carried/ forced on lead	Not applicable
On the way to the veterinary clinic	◯	◯	◯	◯	◯	◯
Arrival in the clinic car park	◯	◯	◯	◯	◯	◯
When entering the clinic	◯	◯	◯	◯	◯	◯
When the waiting room is busy and/or crowded and/or noisy	◯	◯	◯	◯	◯	◯
When the waiting room is quiet and/or calm	◯	◯	◯	◯	◯	◯
If an unfamiliar person (staff or another client) approaches you or your dog	◯	◯	◯	◯	◯	◯
If a familiar person (staff or another client) approaches you or your dog	◯	◯	◯	◯	◯	◯
If an unfamiliar dog approaches you or your dog	◯	◯	◯	◯	◯	◯
If a familiar dog approaches you or your dog	◯	◯	◯	◯	◯	◯
If there are other species in the waiting room (e.g. cats, birds, etc.)	◯	◯	◯	◯	◯	◯

	Calm, relaxed and seemingly unmoved (Or friendly, outgoing, seeking attention)	Alert, but calm and cooperative	Tensed by cooperative, panting slowly, not very relaxed, easily led on lead	Very tense, shaking, whining, will not settle down, panting heavily, difficult to manoeuvre on lead	Extremely stressed, barking/howling, tries to hide/ escape, needs to be carried/ forced on lead	Not applicable
When being weighed on the scales	◯	◯	◯	◯	◯	◯
When entering the consult room	◯	◯	◯	◯	◯	◯
When on the floor in the consult room while the veterinarian talks to you	◯	◯	◯	◯	◯	◯
When on the floor in the consult room while the veterinarian casually interacts with the dog	◯	◯	◯	◯	◯	◯
When on the floor in the consult room while the veterinarian examines the dog	◯	◯	◯	◯	◯	◯
When lifted up onto the consult table for examination	◯	◯	◯	◯	◯	◯
When on the table for examination	◯	◯	◯	◯	◯	◯
When being restrained	◯	◯	◯	◯	◯	◯
When a front paw is lifted for inspection or a nail trim	◯	◯	◯	◯	◯	◯
When a back paw is lifted for inspection or a nail trim	◯	◯	◯	◯	◯	◯
During routine veterinary checks	◯	◯	◯	◯	◯	◯
During veterinary checks where your dog has come in due to illness or injury	◯	◯	◯	◯	◯	◯
When paying for the veterinary visit	◯	◯	◯	◯	◯	◯
When leaving the clinic	◯	◯	◯	◯	◯	◯
When back in the car	◯	◯	◯	◯	◯	◯

28. Has your dog always (for as long as you can reasonably remember) been fearful or stressed during their veterinary visits?

- Yes
- No

If No, can you remember an event or situation that stands out as the cause of their fear or stress?

29. What aspect of a routine veterinary visit do you feel causes your dog themost stress or fear?

- Waiting in the waiting room
- Being in the exam room
- Being around other animals
- Being handled by the veterinarian
- Being restrained by veterinary staff (or yourself) while examined/treated by the veterinarian
- The use of veterinary equipment (e.g. stethoscope, othoscope, nail clippers, etc.)
- Being vaccinated

Other (please specify)

30. How do you feel your dog's reaction to their veterinary visits has changed over time?

- It's quickly getting worse
- It's getting worse
- It's remaining the same
- It's getting better
- It's quickly getting better

Your dog's veterinarian

The following questions are about the veterinarian your dog saw most recently

31. Please indicate the factors that helped you decide which veterinary clinic/ veterinarian to see for this dog

- [ ] We've always used this clinic/ veterinarian
- [ ] Clinic advertising (posters/ signage/ social media)
- [ ] Location (the clinic is easy to get to/ nearby)
- [ ] The clinic/ veterinarian are good with my dog
- [ ] Recommended by friend/ family
- [ ] They advertise as 'fear free'
- [ ] Affordability
- [ ] Other (please specify)

32. Does your veterinarian you saw most recently do any of the below to help your dog cope better with their veterinary visits? (please tick all that apply)

- [ ] Give your dog time to choose to approach/ adapt to the exam room
- [ ] Encourage you to interact with your dog in a positive or supportive way
- [ ] Treat/ examine your dog where they are most comfortable (e.g. in a crate, on your lap, on the floor)
- [ ] Use complementary therapies like Adaptil (dog appeasing pheromones), Thundershirts, etc.
- [ ] Use treats, praise, toys, pats or cuddles to distract your dog

Other (please specify)

33. In this dog's history, have you changed veterinarians in favour of one that has been recommended to better help your dog cope with stress or fear?

- ◯ Yes
- ◯ No

If yes, what specifically was the deciding factor to change veterinarian

Nail trims

The following questions are about your dog's experience with nail trims

34. Do any of your dog's nails need trimming?

- ◯ Yes
- ◯ No

35. How often in a year would you trim your dog's nails on average?

- ◯ Less than once per year
- ◯ Once per year
- ◯ 2 to 3 times per year
- ◯ 3 to 5 times per year
- ◯ Over 5 times per year

36. Who has trimmed your dog's nails in the past?

- ☐ Veterinarian/ Veterinary staff
- ☐ You/ another family member
- ☐ Groomer
- ☐ Other (please specify)

37. Who trimmed your dog's nails the last time they were done?

- ◯ Veterinarian/ veterinary staff
- ◯ You/ another family member
- ◯ Groomer
- ◯ Other (please specify)

38. Has your dog ever had a painful experience during nail trims (e.g. was the quick cut/ did they bleed?)

- ◯ Yes
- ◯ No

If yes, please indicate who was cutting the nails and which paw

39. Please describe your dog's response to the different aspects of having their nails trimmed when you or someone:

	Calm, relaxed and seemingly unmoved (or friendly, outgoing, seeks attention)	Alert, but calm and cooperative	Tensed by cooperative, panting slowly, not very relaxed, easily led on lead	Very tense, shaking, whining, will not settle down, panting heavily, difficult to manoeuvre on lead	Extremely stressed, barking/howling, tries to hide/ escape, needs to be carried/ forced on lead	Not applicable
Picks up their paw	○	○	○	○	○	○
Holds their paw to inspect the nail	○	○	○	○	○	○
Places the clippers over the nail	○	○	○	○	○	○
Clips the nail	○	○	○	○	○	○
Clips nails on the front paws	○	○	○	○	○	○
Clips the dew claws	○	○	○	○	○	○
Clips nails on the back paws	○	○	○	○	○	○

What would you do in the future?

40. Please indicate the extent to which you would be likely to invest time/ resources into the following:

	Very unlikely	Unlikely	Neither unlikely or likely	Likely	Very likely
Training your dog to help them feel more comfortable with veterinary visits	○	○	○	○	○
Training your dog to help them feel more comfortable with nail trims	○	○	○	○	○
Attending the veterinary clinic more frequently (when nothing is wrong) for 'socialisation' visits	○	○	○	○	○
Paying for longer veterinary visits so your veterinarian can take more time / care with your dog	○	○	○	○	○
Attending classes/ seminars to learn more about your dog's behaviour and body language in general	○	○	○	○	○

Thank you for your time in completing this survey. Please sit back and relax, the researchers will be with you shortly.

Appendix 2: Chapter 5 Participant Survey

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

Research project information

You are invited to participate in the research project: Exploring fear-free veterinary care in the Australian veterinary industry

This project is being conducted by Dr. Susan Hazel, Ms Petra Edwards, Dr. Michelle McArthur and Dr. Bradley Smith. This research will form the basis for Petra's PhD degree at the University of Adelaide under the supervision of the investigators listed above. There are no commercial sponsors or external partners or funding involved in this research project.

Why am I being invited to participate?

You are invited to participate because you are a qualified veterinarian or veterinary nurse that currently works with dogs in the veterinary industry (or studying to become one), living and working in Australia, able to read and understand English fluently, and are over 18 years of age.

What am I being invited to do?

If you consent, you will be participating in an online survey asking questions about your attitudes toward fear free veterinary care and your attitudes toward animals generally. We expect the survey will take approximately 15min for your time, and you can withdraw from the survey prior to submission at any time. There are no expected physical or emotional risks associated with participating in this research project.

What are the potential benefits of the research project?

We hope this research project will increase our understanding of the Australian veterinary industry's attitudes toward fear-free veterinary care and how often they use fear-free techniques. This project also aims to investigate the relationship between attitudes to animals generally and attitudes toward and implementation of fear-free veterinary care. This will likely influence future research into strategies to reduce fear in the veterinary context based on the attitudes of veterinary staff and veterinary students. We hope this research may have an impact on the ability for veterinary staff to reduce fear in the veterinary context and therefore reduce the risk of injury to veterinary staff working with dogs.

1

What will happen to my information?

Your survey responses will be anonymous. There will be no identifiable data collected from your participation in this survey. As such, there are no perceived risks to your privacy or confidentiality.

Your anonymous survey responses will be kept on an external hard drive during analysis. Upon completion of the study, your anonymous data will be kept on the University of Adelaide protected network, where only Chief Investigator, Dr. Susan Hazel, will have access.

The researchers aim to publish the results of this research project as part of a PhD thesis and in a scientific journal, and hope to present it at scientific or industry conferences. Sometimes as part of publication, the journal requires data to be loaded to an online repository (eg. Figshare). The non-identifiable data will be uploaded, and may be used by other researchers. If this is the case.

Your information will only be used as described in this participant information sheet and it will only be disclosed according to the consent provided, except as required by law.

If you have any questions about the project, please contact:

Dr Susan Hazel
Susan.hazel@adelaide.edu.au | Phone: (08) 8521 2825

Ms Petra Edwards
Petra.edwards@adelaide.edu.au | Phone: (08) 8313 7381

The study has been approved by the Human Research Ethics Committee at the University of Adelaide (approval number H-2019-xxx). This research project will be conducted according to the NHMRC National Statement on Ethical Conduct in Human Research 2007 (Updated 2018). If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult the Principal Investigator.

If you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Human Research Ethics Committee's Secretariat on:

Phone: +61 8 8313 6028
Email: hrec@adelaide.edu.au
Post: Level 4, Rundle Mall Plaza, 50 Rundle Mall, ADELAIDE SA 5000

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If you would like to participate in the survey: Please click 'Next' to provide your consent and begin.

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

Consent

2

I have read the previous information sheet and agree to take part in the research project: exploring fear-free veterinary care in the Australian veterinary industry (HREC approval # H-2019-***).

- I understand my responses are anonymous and I can withdraw at any time
- I agree to my anonymous information being used as detailed in the previous participant information sheet
- I understand the information gained in the project may be published in a book/ journal article/ thesis/ news article/ conference presentations/ website/ reports, etc.
- I agree to my anonymous information being used for future research purposes, including projects undertaken by any researchers
- I understand my information will only be disclosed according to the consent provided, except where disclosure is required by law.

If you would like to keep a copy of this research project information sheet and consent form, please email the researchers Dr. Susan Hazel (susan.hazel@adelaide.edu.au) or Ms. Petra Edwards (petra.edwards@adelaide.edu.au).

* 1. I consent to participate in this research project

○ Yes

○ No

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

Questions about you and your work/ study

2. What is your age (to the nearest year)?

[ ]

3. What is your gender

○ Female

○ Male

○ Non-binary

○ Prefer not to say

4. What are your qualifications? (please tick all that apply)

☐ Veterinary degree

☐ Veterinary Nursing certificate IV

☐ Veterinary Technician Bachelor/ certificate

☐ I am currently studying to be a veterinarian

☐ I am currently studying to be a veterinary nurse

☐ Other (please specify)

[ ]

3

5. In which year did you graduate (or which year do you expect to graduate?)

____

6. Which type of practice do you work in?

- ◯ Small animal (general)
- ◯ Small animal (specialist) (e.g. emergency, orthopaedics, etc.)
- ◯ Mixed practice (general)
- ◯ Mixed practice (specialist) (e.g. emergency, orthopaedics, etc.)
- ◯ N/A
- ◯ Other (please specify)

____

7. How long have you been in this current role (to the nearest year)?

____

8. What is your current role in a veterinary clinic?

- ◯ Veterinarian
- ◯ Veterinarian with ANZCVS membership in behaviour (or above)
- ◯ Veterinarian with other ANZCVS membership (e.g. equine, emergency, orthopaedics, etc.) (or above)
- ◯ Veterinary nurse
- ◯ Practice manager/ owner
- ◯ Animal/ kennel attendant
- ◯ Receptionist
- ◯ Locum veterinarian
- ◯ Locum veterinary nurse
- ◯ N/A
- ◯ Other (please specify)

____

9. In what capacity are you employed in?

- ◯ Permanent full time
- ◯ Permanent part time
- ◯ Locum veterinarian
- ◯ Locum veterinary nurse
- ◯ Casual
- ◯ Currently studying
- ◯ Other (please specify)

____

10. Do you work in a corporate clinic (e.g. Greencross)

- ◯ Yes
- ◯ No
- ◯ N/A

4

11. What postcode is your clinic in?

[ ]

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

Questions about your familiarity with fear-free veterinary care

'Fear-free' can be defined as: 'taking steps to reduce signs of fear, anxiety or stress in every patient, every time'. Common steps that are recommended include: approaching from the side and allowing the dog to approach you first, observing signs of fear, stress or anxiety, using food treats and lures to move dogs around the clinic, onto the scales or into the consult room, using food treats, toys or pats to help the dog through the examination, assessing whether the examination has to occur today or whether the dog can come back another time with more effective strategies to reduce stress, etc.

12. Please indicate whether you have completed any of the below formal certifications

- [ ] Fear-free certification for vet professionals (level 1)
- [ ] Fear-free certification for vet professionals (level 2)
- [ ] Fear-free certification for vet professionals (level 3)
- [ ] Other fear-free certifications (e.g. for groomers/ trainers/ shelters)
- [ ] Low stress handling university Silver (Sophia Yin)
- [ ] Low stress handling university Gold (Sophia Yin)
- [ ] Better veterinary visits (Karen Pryor Academy)
- [ ] I am currently studying to become fear-free / low stress handling certified
- [ ] I do not have a fear-free / low stress handling certification
- [ ] Other (please specify)

13. Would you like to learn more about fear-free veterinary care?

- ( ) Yes
- ( ) No
- ( ) Other (please specify)

14. Is the clinic/practice you work in advertised as "fear-free"?

- ( ) Yes
- ( ) No
- ( ) Other (please specify)

15. Please use the slide bar to indicate the extent to which you agree or disagree with the following statement:

All of the staff where I work place equal importance on fear-free practice

Strongly disagree — Strongly agree

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

The following questions are about your attitudes toward fear-free veterinary care generally

'Fear-free' can be defined as: 'taking steps to reduce signs of fear, anxiety or stress in every patient, every time'. Common steps that are recommended include: approaching from the side and allowing the dog to approach you first, observing signs of fear, stress or anxiety, using food treats and lures to move dogs around the clinic, onto the scales or into the consult room, using food treats, toys or pats to help the dog through the examination, assessing whether the examination has to occur today or whether the dog can come back another time with more effective strategies to reduce stress, etc.

Please use the slide bar to indicate the extent to which you agree or disagree with the following statements.

16. Fear-free veterinary care is important to me

Strongly disagree — Strongly agree

17. Fear-free veterinary care is important to my workplace

Strongly disagree — Strongly agree

18. Fear-free veterinary care is important to my clients

Strongly disagree — Strongly agree

19. Fear-free veterinary care is important to the Australian veterinary industry

Strongly disagree — Strongly agree

20. I have the clinical resources to use fear-free techniques in my daily practice

Strongly disagree — Strongly agree

21. My clinical environment is set up to use fear-free techniques in my daily practice

Strongly disagree — Strongly agree

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

The following questions are about implementing fear-free veterinary care in Australia

'Fear-free' can be defined as: 'taking steps to reduce signs of fear, anxiety or stress in every patient, every time'. Common steps that are recommended include: approaching from the side and allowing the dog to approach you first, observing signs of fear, stress or anxiety, using food treats and lures to move dogs around the clinic, onto the scales or into the consult room, using food treats, toys or pats to help the dog through the examination, assessing whether the examination has to occur today or whether the dog can come back another time with more effective strategies to reduce stress, etc.

Please use the slide bar to indicate how often you use fear-free techniques in daily practice.

22. How often do you use fear-free techniques with dogs in your daily practice?

Never — Always

23. How often do you use fear-free techniques with dogs in the waiting room?

Never — Always

24. How often do you use fear-free techniques with dogs in the consult room?
(Please leave this question blank if not applicable)

Never — Always

Please use the slide bar to indicate how often you use the following examples of fear-free veterinary care.

25. Calming/ enriching scents (e.g. Adaptil, diluted lavender) or sounds (e.g. classical music) in at least one location of clinic

Never Always

26. Encourage owners to bring their dog's favourite toy, treats or a mat

Never Always

27. In waiting room, spread patients out as far as possible

Never Always

28. In the exam room, allow time (>2min) for the dog to habituate before beginning exam

Never Always

29. In the exam room, examine patient where they are most comfortable (e.g. client's lap, on the floor)

Never Always

30. In the exam room, use non-slip surfaces on the floor and /or examination table

Never Always

31. In the kennels/ housing, use visual barriers (e.g. a towel over the front of the cage)

Never Always

32. Are there any other fear-free techniques you use frequently that you feel are important to helping reduce fear or stress in dogs during veterinary visits?

33. What do you think are the barriers for implementing fear-free veterinary care in clinical practice?

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

The following questions are about your attitudes to animals

34. Listed below are a series of statements regarding the use of animals. Please indicate the extent to which you agree or disagree with the statement

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
It is morally wrong to hunt wild animals just for sport.	○	○	○	○	○
I do not think that there is anything wrong with using animals in medical research.	○	○	○	○	○
There should be extremely stiff penalties including jail sentences for people who participate in cock-fighting.	○	○	○	○	○
Wild animals, such as mink and raccoons, should not be trapped and their skins made into fur coats.	○	○	○	○	○
There is nothing morally wrong with hunting wild animals for food.	○	○	○	○	○
I think people who object to raising animals for meat are too sentimental.	○	○	○	○	○
Much of the scientific research done with animals is unnecessary and cruel.	○	○	○	○	○
I think it is perfectly acceptable for cattle and hogs to be raised for human consumption.	○	○	○	○	○
Basically, humans have the right to use animals as we see fit.	○	○	○	○	○

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The slaughter of whales and dolphins should be immediately stopped even if it means some people will be put out of work.	○	○	○	○	○
I sometimes get upset when I see wild animals in cages at zoos.	○	○	○	○	○
In general, I think that human economic gain is more important than setting aside more land for wildlife.	○	○	○	○	○
Too much fuss is made over the welfare of animals these days when there are many human problems that need to be solved.	○	○	○	○	○
Breeding animals for their skins is a legitimate use of animals.	○	○	○	○	○
Some aspects of biology can only be learned through dissecting preserved animals such as cats.	○	○	○	○	○
Continued research with animals will be necessary if we are ever to conquer diseases such as cancer, heart disease, and AIDS.	○	○	○	○	○
It is unethical to breed purebred dogs for pets when millions of dogs are killed in animal shelters each year.	○	○	○	○	○
The production of inexpensive meat, eggs, and dairy products justifies maintaining animals under crowded conditions.	○	○	○	○	○

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	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The use of animals such as rabbits for testing the safety of cosmetics and household products is unnecessary and should be stopped.	◯	◯	◯	◯	◯
The use of animals in rodeos and circuses is cruel	◯	◯	◯	◯	◯

35. Is there anything else you wish to add?

Exploring Australian veterinary industry attitudes to reducing fear in the vet clinic

Thank you for your time!

This research project is expected to be published within a year of completion. If you would like to receive a summary of the results of this project, please email Chief Investigator, Dr. Susan Hazel: susan.hazel@adelaide.edu.au