Improving the Welfare of Cats During Handling and Restraint

by

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ABSTRACT

IMPROVING THE WELFARE OF CATS DURING HANDLING AND RESTRAINT

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Dr. Lee Niel
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This thesis aimed to provide evidence-based recommendations for improving cat welfare during handling. First, a cat handling questionnaire suggests that veterinarians (n=344) and non-veterinarian staff (n=944), commonly use restraint involving immobilization for examinations and procedures when handling fearful and aggressive cats. Participants were less likely to use full-body with scruff restraint (known negative) on fearful (F) and aggressive (A) cats if they work: at a Cat-Friendly Practice® (F: P=0.0001; A: P=0.0001), in Canada (F: P<0.0001; A: ns), as a veterinarian (F: P<0.0001; A: ns), or as a non-veterinarian who graduated in 2005 or earlier (F: P<0.0001; A: P<0.0001). Given a lack of scientific evidence to inform good handling, methodologies were validated to assess cat responses to handling by comparing full-body (known negative) and passive (control) restraint. Cats were categorized as friendly or unfriendly based on interactions with a stranger, given the hypothesis that unfriendly cats would display more avoidance behaviours than friendly cats. Conditioned place aversion (CPA) was validated for use with laboratory (n=10) and friendly shelter (n=26) cats, using a two-compartment apparatus; cats showed aversion towards the compartment where full-body restraint occurred (P=0.043; P=0.035). Shelter cats were used to validate behavioural and physiological response differences between passive (n=22) and full-body (n=25) restraint. Full-body restrained cats showed a higher respiratory rate (P=0.004), more lip licks (F_{1,42} = 6.18; P = 0.017), more side/back ear positions (P<0.0001), and a greater pupil dilation (unfriendly full-body vs unfriendly passive, P=0.0007), than passively restrained cats.
These responses were then used to assess cat responses to scruff (n=17), clip (two clips applied to neck skin; n=16), and full-body (negative; n=19), compared to passive restraint. The number of negative responses were highest in full-body (respiratory rate P=0.01; ear P=0.0007, pupil P=0.004, vocalizations P=0.005) and clip (pupil P=0.01, vocalizations P=0.007, ear P=0.02) restrained cats. The results for scruffed cats showed mixed results in comparison to the other restraint groups. This thesis provides the first validated methodologies to assess cat responses to restraint, and suggests that clip restraint may be more negative to scruff restraint, showing a need for further research on alternatives.
Dedication

This thesis is dedicated to all the cats that have endured negative experiences during handling and restraint.

A special dedication goes to my beloved brown tabby *Angus*, in addition to all the pet cats I have owned over the years (Toffee, Sneakers, Oreo, Missy, Luciano, Wesley, Hirshel, Olive), for providing a major source of motivation and inspiration for this thesis.
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Statement of Work

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Chapter 1: Introduction and Literature Review

Articles used were identified by Carly Moody, who conducted literature searches using various online databases. The initial draft was written by Carly Moody, with review and editing provided by Dr. Lee Niel. Additional revisions were provided by Dr. Cate Dewey and Dr. Georgia Mason.

Chapter 2: A Cross-Sectional Survey of Cat Handling Practices in Veterinary Clinics Throughout Canada and the United States

The survey questions were created by Carly Moody, under guidance by Dr. Lee Niel, and additional input by Dr. Cate Dewey. Images of various handling techniques were provided by anonymous donors and the American Association of Feline Practitioners. Carly Moody and research assistant Justine Antunes compiled invitation lists and distributed the survey. Questionnaire data management and
analyses was completed by Carly Moody, with guidance from Dr. Cate Dewey, and statistician William Sears. The initial manuscript draft was written by Carly Moody, with review and editing by Dr. Lee Niel and Dr. Cate Dewey.

Chapter 3, 4, and 5: Cat Responses to Restraint

Carly Moody and Dr. Lee Niel developed the methodologies to be tested, with additional input provided by Dr. Georgia Mason. Carly Moody made methodological refinements following pilot testing, with guidance from Dr. Lee Niel. Research assistants that provided help during testing, and behavioural and physiological scoring during and after testing were: Chapter 3: Siobhan Mellors, Jackie Jacobs, Laura Bona, Justine Antunes, Aileigh Kay, Sophia Lee, Quinn Rausch, Anastasia Stellato, Emma Nip, Amanda Armstrong, and numerous staff members at Cancog Technologies, Chapter 4: Victoria Picketts, Melissa Speirs, Heidi Eccles, and Hailey Hoffman, Chapter 5: Justine Antunes, Sophia Lee, Siobhan Mellors. Data management and analyses were conducted by Carly Moody, with guidance from Dr. Lee Niel and statistician William Sears. The initial manuscript drafts were written by Carly Moody, with review and editing by Dr. Lee Niel. Additional revisions were provided by Dr. Georgia Mason (Ch.3,4,5) and Dr. Cate Dewey (Ch.3,4,5), and Victoria Picketts (Ch.4).

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Chapter 6: General Discussion

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List of Abbreviations

A – Aggressive

AAFP – American Association of Feline Practitioners

CPA – Conditioned Place Aversion

CPP – Conditioned Place Preference

F – Fearful
Chapter 1: Introduction and Literature Review

1. Introduction

1.1 Cat Handling and Restraint

Owned, shelter, and laboratory cats are handled for routine examinations and procedures throughout their lifetime. Estimates suggest there are over 100 million owned cats throughout Canada and the USA (American Pet Products Association, 2017; Canadian Animal Health Institute, 2017), in addition to cats living in shelter and laboratory facilities for which accurate numbers are not currently available. Owned cats are regularly brought to veterinary clinics for routine health examinations, including any necessary procedures. Shelter cats undergo facility intake examinations and any necessary procedures such as surgical sterilization or dental extractions, in addition to daily handling required for medication administration and cage changing. Laboratory cats undergo handling and restraint for yearly health examinations and necessary procedures, in addition to handling necessary for research purposes. Health care is largely provided by veterinary professionals (veterinarians) and other industry members (veterinary technicians, veterinary assistants, research assistants, shelter animal care workers), on owned, shelter, and laboratory cats, with choice of handling methods and competency at using these methods, receiving little oversight from related professional organizations. This thesis will largely focus on handling of companion cats in the context of the veterinary clinic, but the approaches and findings are also relevant to handling in other contexts, such as in shelters and research facilities.

1.2 Animal Welfare and Animal Ethics

Animal welfare science arose from ethical concerns about animal quality of life (Fraser et al., 1997), with welfare ranging on a continuum from negative to positive, based on the individual experiences of an animal. Animal welfare has been defined in a variety of different ways, but understanding an animal’s affective state is thought to be key to understanding its welfare (Duncan, 1996; Dawkins, 1988). An affective state is an individual animal’s consciously perceived subjective emotional
state, which represents an animal’s current experience (Mellow, 2016). Affective states have valence (positive or negative), and are motivated by the positive-ness of rewards (something an animal will work for; Rolls, 2014), or the negative-ness of punishers (something an animal is motivated to avoid or escape; Rolls, 2014; Mendl et al., 2017). When using the three circles view of animal welfare, other areas considered include biological functioning (good health and physiological functioning), and natural living (access to natural stimuli and expression of natural behaviours; Fraser et al., 1997; Duncan, 2008).

Another dominant model in animal welfare science suggests examination of five different domains focusing on an animal’s affective state, nutrition, environment, health, and behaviour (Mellor, 2017). These domains are used as guidelines for assessing an animal’s welfare, prospectively or retrospectively (Mellor, 2017). While a consensus on the precise definition of welfare may not exist among scientists, there is a tendency to focus on reducing negative experiences (e.g., pain, frustration, boredom), and increasing positive experiences (e.g., play, social contact, eating palatable food) for animals (Mellor, 2016; Green and Mellor, 2001). Although animals will have various positive and negative experiences throughout their lifetime, good welfare focuses on positive experiences dominating overall (Mellor, 2016; Green and Mellor, 2001). For the purposes of the current thesis, animal welfare will be defined based on an animal’s emotional state, referred to as affective state.

Interactions between humans and companion animals (e.g., cats, dogs) can both increase or decrease an animal’s welfare, given that humans are largely in control of the animal’s environment and resources (Mellor, 2016). For example, in a veterinary clinic setting, providing a hiding place for caged cats that are in clinic all day for various procedures or surgery, may decrease fear or stress elicited by a noisy and novel clinic environment. Another example is restraint techniques used to handle cats in a veterinary clinic setting. If the handling and restraint methods used are negatively perceived, a cat’s welfare may be compromised. Thus, it has been suggested that animal welfare and animal ethics should be taught in all courses and roles in which people will be handling and caring for animals (Verrinder and Phillips, 2017).
In recent years, there has been increased discussion by the veterinary industry regarding the welfare impacts of how cats are handled and restrained (Patronek and Lacroix, 2001). It is important for veterinary professionals to be aware of changing social ethics applied to companion animals (Patronek and Lacroix, 2001), in addition to changing industry standards. Only recently have animal welfare topics been added to veterinary courses, although depth and specific topics of coverage likely vary with individual programs (Magalhaes-Sant’ana et al., 2009; 2001; Morton, 2010). Generally, professional ethics is covered in all programs, focusing on behavioural expectations as outlined by a code of practice, but little is known about coverage of animal welfare and ethical behaviour towards animals (Verrinder and Phillips, 2017). Verrinder and Phillips (2017) suggests that when teaching animal welfare in veterinary programs, a discussion about ethical behaviour towards animals should be included.

The following introduction will review how negative cat responses to handling and restraint can be validated, outline recommended handling methods, and discuss current knowledge and gaps regarding the welfare of cats during handling and restraint in veterinary clinics, and other environments where cats are handled, such as laboratories and shelter facilities.

2. Validation of Responses

2.1 Validating Negative Cat Responses to Restraint

While several studies have assessed cat responses to different aspects of handling, to date no cat responses have been validated specifically as indicators of negative responses to handling. When validating animal welfare measures, it is important to ensure that what is being measured, actually measures what is thought to be measured (Cronbach and Meehl, 1955; Martin and Bateson, 2007). Other important factors include accuracy of the measurement (consistent and repeatable; Martin and Bateson, 2007), in addition to being feasible for use in practice. Effective measures, when powered correctly, will be able to distinguish between treatment groups (Weary et al., 2006). In addition, when assessing whether responses can identify experiences of individual animals for practical applications in a clinical setting, it
is also important to assess sensitivity and specificity (e.g., the likelihood of false positives and false negatives). However, for the research included in this thesis, differences were examined at the group level, so this level of scrutiny is not necessary.

Both objective and subjective measures can be used to assess animal welfare (Meagher, 2009; Weary et al., 2006). An objective measure should not be biased by personal opinions, and should lead to a factual result (Meagher, 2009). For example, use of blinding during scoring of behavioural measures, and use of precise and detailed operational definitions, may help reduce biases resulting in more reliable and repeatable measures (Martin and Bateson, 2007). Subjective measures use observer judgement of what is being observed, and thus may be less reliable with repeated measurements (Meagher, 2009; Weary et al., 2006). In addition, using subjective measures may increase the variability of scoring outcomes between observers, requiring a greater number of animals to investigate a problem. Thus, limitations with subjective measures make it important to use objective methods when possible.

There are different approaches for validating whether a response is indicative of welfare (i.e., affective states) in animals. Some examples of validation approaches include examination in the following contexts: if a measure changes upon exposure to something that is a known negative or positive stimulus, if a measure influences an animal’s fitness, or if a measure correlates with human responses in similar situations with a positive or negative stimulus. For example, using sympathetic activation measures seen in humans reporting negative affect, and examining the same sympathetic responses in cats exposed to an avoidance-inducing stimulus. Sympathetic responses have been associated with fear in animals (Kreibig, 2010), and include increased respiration, heart rate, blood pressure, and pupil dilation, which may increase in aversive situations (Moberg, 2000). However, these responses also increase with other activities that may not be negatively perceived, such as during play; thus, use of these types of measures are not helpful for treatments where the valence of a treatment is unknown (Moberg, 2000).

A main validation approach for this thesis was to use a known-negative treatment (full-body restraint) to examine animal response differences when compared with a known-control treatment.
(passive restraint). Behavioural (e.g., ear position, lip licking) and physiological (e.g., respiratory rate, pupil dilation) response differences seen between cats restrained with full-body versus passive restraint were used as measures of negative responses to handling. A second testing approach used in this thesis was based on avoidance behaviour in cats. Animals tend to exhibit avoidance behaviour towards stimuli that are negative; an evolutionary survival response to avoid something potentially harmful (Dawkins, 1990). For example, cats have been shown to avoid an area within a T-maze where they underwent a foot shock, showing avoidance to a stimulus that is harmful (Roberts, 1958). In contrast, approach behaviour is used to examine what is preferred by an animal (Broom, 1991). Examining strength of a preference is more useful than just preference itself, since it assesses the magnitude of the response (Broom, 1991). For example, Duncan and Kite (1987) used a weighted door to measure the strength of hens’ motivation to gain access to a nest box; results suggest they will work hard for access, and are therefore highly motivated to use nest boxes.

2.2 Handling Treatments for Use in Validation

Full-body restraint (full-body immobilization) is a stimulus that is known to be negative, given that forced full-body immobilization elicits struggling (avoidance behaviour) and negative vocalizations (growling, hissing; Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988), and is used as a psychological stressor to model stress in a variety of species (Buynitsky and Mostofsky, 2009), including cats (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993). Full-body restraint in cats has also been associated with sympathoadrenal activation measured by increased tonic heart rate and plasma norepinephrine levels (Abercrombie and Jacobs, 1987). Although physiological responses do not indicate valence (positive or negative direction), and are a general sign of arousal, they can be used together with behavioural responses that indicate valence (e.g., negative responses such as avoidance and withdrawal) as a measurement of magnitude.

On the other end of the handling spectrum, passive restraint is a cat handling technique requiring minimal contact and involving the least amount of behavioural restriction. Thus, passive restraint is the
most neutral handling technique; however, it might still elicit some low level negative responses, given interactions with humans and mild behavioural restriction is still occurring. To validate negative cat responses to restraint, we can therefore assess response differences between cats restrained with the known negative (full-body), and control (passive) restraint techniques. To our knowledge, no one has validated negative responses to handling in cats using this approach or any other approaches.

2.3 Aversion Testing Paradigms

Various behavioural paradigms have been used to examine aversion in response to handling in animals, including approach-avoidance tests (e.g., runway style set up, Rushen, 1986a) and conditioned place aversion tests (e.g., using two-way shuttle boxes; McClearly, 1961). In these types of preference tests, the magnitude of aversion can be assessed by measuring passive responses such as latency to approach, or distance from an area or person that the animal perceives as negative (Kirkden and Pajor, 2006).

Handler aversion tests have been used mainly in livestock research to examine the motivation of an animal to avoid or approach a handler after a handling treatment is applied to an animal by a particular person. Treatments applied during aversion tests have included physical restraint, hitting, yelling, kicking (cows, goats; Breuer et al. 2003; Munksgaard et al., 1997, Mersmann et al., 2016; Pajor et al., 2000; Pajor et al., 2003), and full-body restraint (sheep; Grandin et al., 1986; Rushen, 1986b). Rough handling has been shown to increase aversion responses in comparison to gentle handling in many species such as dairy cattle, sheep, goats, and mice (Gouveia and Hurst, 2003; Mersmann et al. 2016; Munksgaard et al., 1997, Lurzel et al., 2016; Rushen, 1986a; Pajor et al., 2003). Animal responses to the handler post-handling have been examined using: latency to approach the handler (dairy heifers: Breuer et al., 2003), avoidance behaviour observed during the approach of the handler (dairy heifers: Lurzel et al., 2016; Breuer et al. 2003), avoidance distance from a handler (dairy cows: Munksgaard et al., 1997), approach and avoidance behaviour towards an unfamiliar person (dairy goats: Mersmann, 2016), latency to enter and proceed down a runway (a long narrow passage) towards a handler (dairy cows: Pajor et al., 2000;
sheep: Rushen, 1986a,b), and force required to move an animal down a run towards a handler (dairy cows: Pajor et al., 2000). Generally, these handler aversion tests have used set-ups that did not involve a race or runway apparatus, such as the animal’s home pen (Lurzel et al., 2016; Breuer et al. 2003; Munksgaard et al., 1997; Mersmann, 2016; Rushen, 1986b; Grandin et al., 1986). However, some have used a Y-maze (Pajor et al., 2003; Rushen, 1986a), and one used a race with 2-m high sides (Pajor et al., 2000). Although these types of handler aversion tests have not previously been performed using cats, other studies have shown that cats can be trained to walk maze structures (Sherman et al., 2013; Mayes et al., 2015; Norrsell, 1974), and walkways (Robert, 1958; Lindstrom and Norrsell, 1971; Stiegerwald et al., 1999), suggesting it should be possible to run these types of studies with cats. Moreover, one study by Roberts (1958) applied foot shock to cats to induce an avoidance response to a particular area within a T-maze, suggesting cats will avoid an area where a negative stimulus was experienced.

Conditioned place avoidance (avoiding an area associated with a negative stimulus) and conditioned place preference (preferring an area associated with a positive stimuli) are classical conditioning paradigms that have been used in humans and non-human animals to examine learning, memory, and motivational behaviour (Hutson et al., 2013). Learned place conditioning paradigms, where a particular stimulus is associated with a particular location, have been used successfully in many species (mice, rats, zebrafish, goldfish, hamsters; Tschentke, 2007) including cats (McClearnly, 1961; McAdam, 1964; Lubar 1964; Robert, 1958; Sarkisov et al., 2002). The conditioned place avoidance (CPA) paradigm, which examines learned avoidance responses using a two-compartment shuttle box, has been used in cats to examine responses to negative stimuli, such as a foot shock (McClearnly, 1961; McAdam, 1964; Lubar 1964; Robert, 1958; Sarkisov et al., 2002); in these studies, cats learned to avoid the compartment where the shock occurred, showing aversion towards a harmful stimulus. However, to our knowledge, restraint has not yet been used as a stimulus to condition a learned avoidance response in cats.
2.4 Behavioural and Physiological Measures for Assessment During Validation

Responses elicited during restraint include behavioural and physiological responses that can be measured during restraint. Full-body restraint has been shown to elicit behavioural responses in cats, with one study reporting that cats show increased vocalizations and struggling behaviour during restraint (Abercrombie and Jacobs, 1988). Actual or attempted avoidance behaviours (e.g., struggling, leaving with a short latency) have been widely used to assess aversive experiences in animals and are known to be associated with fear and acute stress (Archer, 1979). Cats have also shown an increased resting heart rate and plasma norepinephrine concentration during full-body restraint, suggesting sympathetic activation (Abercrombie and Jacobs, 1987; Wilkinson and Jacobs, 1988). In addition, during handling for physical examinations, cats show increases in body temperature, heart rate, and respiratory rate; physiological responses indicating activation of the sympathetic-adrenal system (Belew et al., 1999; Nibblett et al., 2015; Quimby et al., 2011). A study by Lockhart et al. (2013) also found an increase in struggling behaviour during handling, with a greater amount of struggling when handling was performed by an unfamiliar versus familiar person.

Electrical stimulation of the amygdala and adjacent structures in the forebrain is also known to cause fear and defensive reactions; stimulation of these regions in cats produces a general defense pattern including back or flattened ears, lowering of the head, a hunched back, vocalizations such as growling and hissing (Kaada et al., 1953; Delgado et al. 1954; Kaada and Ursin, 1957; De Molina et al. 1959), and pupil dilation (De Molina et al., 1959; Kaada and Ursin, 1957). In recent literature, flattened and back ear positions have been interpreted as signs of fear in cats housed in catteries (Kessler and Turner, 1997), during veterinary examinations (Nibblett et al., 2015), and during agonistic interactions (Leyhausen, 1979); however, this has not yet been validated. Another response that occurs during exposure to negative conditions is lip licking (non-appetitive lick of the upper lip area and / or nose), which was found to be increased in shelter cats exposed to an unenriched cage environment (Stella et al., 2014), and anecdotally, has been associated with negative responses during veterinary physical examinations (Frank, 2014). Other
authors have reported increased lip licking in caged shelter cats when they are trying to avoid a human, or during escape attempts within the cage environment (Gourkow and Phillips, 2016; Gourkow and Phillips, 2015). Cats have also been observed to show tail lashing in response to a fear-provoking stimulus (Watson, 1953), and during brain stimulation of the cerebellum, an area associated with fear and affective states (Dow and Moruzzi, 1958; Sacchetti et al., 2005).

2.5 Summary

In summary, validation of response measures used to examine cat responses to handling are important to ensure what is being measured actually measures what is intended to be measured; in addition to being consistent, reliable, and practical. Use of aversion testing and response differences detected between a known-negative (full-body) and control (passive) restraint technique, are useful methods for use in validating negative cat responses to restraint. Potential behavioural and physiological measures of negative responses to handling in cats include increased heart rate, respiratory rate, struggling, vocalizations, side and back ear positions, lip licking, pupil dilation, and avoidance towards an area where full-body restraint occurred. Currently there is a lack of validated measures that can be used to assess cat responses to handling and restraint, thus, this is a main aim of the current thesis.

3. Cats and the Veterinary Clinic

3.1 Negative Experiences

Recent reports suggest that there are more pet cats than pet dogs throughout Canada (8.8 million cats versus 6.7 million pet dogs; Canadian Animal Health Institute, 2017), the USA (94.2 million cats versus 89.7 million pet dogs; American Pet Products Association, 2017), and Europe (> 100 million pet cats versus 86.7 million pet dogs; European Pet Food Industry, 2016). Cats require routine veterinary care throughout their lifetime to maintain their health and welfare, and it is recommended that they visit the veterinarian annually for preventive care. However, in the past 20 years, cat visits to the veterinary clinic have been on a steady decline in Canada and the USA (Gauvin, 2015; Volk et al., 2011a, Volk et al.,
One study in Central Italy reports that only 43% of pet cats visit the veterinarian 1-2 times per year (Carvelli et al., 2017), and a study out of the USA reports that only 48% of cats were brought to the veterinarian in the past year (Volk et al., 2011a; Volk et al 2011b, Volk et al., 2014). These figures suggest that about half of cat owners do not bring their cats to the veterinary clinic for routine health care. A study conducted to understand why veterinary visits for cats are so low, states that many reasons exist including lack of knowledge regarding the value of preventive health care, cost, cat resistance to carriers and travel, and previous stressful experiences at the veterinary clinic (Volk et al., 2014). Furthermore, cat owners report that a veterinarian’s ability to handle their cat provides an initial assessment of pet care quality, and that rough or careless handling results in a negative perception of their veterinarian (Mariti et al., 2016).

In previous studies, cat owners have reported that they think their cat is stressed during veterinary visits and examinations (Mariti et al., 2016; Volk et al., 2011). A survey-based study conducted in Italy found that during handling in the examination room, about 50% of owners reported that their cat is stressed during handling (Mariti et al., 2016). In addition, 23% of participants reported that their cat shows aversive behaviour during examinations by trying to escape during handling, and 9% of participants reported that their cat is aggressive during examinations. One study assessed 100 cats during routine physical examinations, and categorized 42 cats as agitated, fearful or reserved, and 13 cats as dangerous or aggressive (Glardon et al., 2010). This study confirms owner reports suggesting that many cats have negative experiences during handling in the veterinary clinic.

Recent literature also suggests that cats respond negatively to unfamiliar environments, including veterinary clinics (Griffith et al., 2000; Quimby et al., 2011; Belew et al., 1999; Cauvin et al., 2003). Although no studies have validated cat responses to veterinary clinic stimuli, one study by Nibblett et al. (2015) reports that cats show hiding behaviour during examination in a clinic environment in comparison to the cat’s home environment. Hiding behaviour has shown to be a negative response in cats, with increased attempts to hide when exposed to stressors (Carlstead et al., 1993). Moreover, three different
studies have found that cats show increased physiological arousal during examinations in clinic, with increased blood pressure, heart rate, and respiratory rate seen in cats examined in a veterinary clinic in comparison to the cat’s home environment (Quimby et al., 2011; Belew et al., 1999; Conti et al., 2017). In addition, research has found an increase in cat blood pressure (Belew et al., 1999) and hyperglycemia (Nibblett et al., 2015; Rand, 2002) during handling for a veterinary examination in a clinic setting versus the home environment. These studies suggest that cats may be more aroused in a clinical versus home setting during handling for routine examinations. Although increases in physiological parameters are more indicative of arousal than negative responses and suggest greater sympathetic activation, this type of activation has been previously associated with fear responses (Kreibig, 2010). Given the current evidence that cats show hiding behaviour (Nibblett et al., 2015) and other signs of fear and aggression (Glardon et al., 2010) during routine veterinary examinations, suggests this experience may be negative for cats; however, this has yet to be validated. Chapter 4 of this thesis aims to fill this knowledge gap by validating negative cat responses to handling.

Negative experiences in the clinic directly impair the welfare of cats, and are also likely to be remembered by the cat, increasing the potential for increased fear and/or aggressive behaviour upon subsequent visits. This can potentially lead to difficulties with examinations, and inadequate or inaccurate diagnosis and treatment (Glardon et al., 2010; Rodan, 2010). Owners report that a stressful clinic experience deters them from bringing their cat back (Volk et al., 2011a; Volk et al., 2011b, Volk et al., 2014). Veterinarian anecdotes suggest a consequence of this is delayed visits, such that sick and injured pets do not get necessary care in a timely manner (Volk et al., 2011b). Thus, current evidence suggests that while the handling and restraint required for many examinations and procedures is generally acute and short lasting, if the cat and the owner interpret it as negative, this may have long-lasting adverse health and welfare effects for the cat.
3.2 Cat Handler Injuries

The most common animal-related injuries occurring in staff in companion animal veterinary clinics are cat bites and scratches (Fowler et al., 2016; Jeyaretnam and Jones, 2000; Gibbins and MacMahon, 2015; Nordgren et al., 2014; Nienhaus et al., 2005). These injuries often occur on the handler’s arms and hands when restraining cats (Nordgren et al., 2014; Nienhaus et al., 2005), and are most likely to occur in the examination and treatment rooms (Gibbins and MacMahon, 2015). In the past, full-body restraint was used to immobilize a cat for examinations and procedures for the sake of efficiency, and was thought to reduce risk of injury, with little consideration of a cat’s welfare (Moffat, 2008). It is important that appropriate handling and restraint methods are used that reduce injury for the handler as well as the cat. Handlers should be able to read a cat’s behaviour during handling, to identify fear behaviour that may precede aggressive behaviour, and to adjust their handling accordingly (Gibbins and MacMahon, 2015). In veterinary clinics, non-veterinarian staff members perform a large amount of animal handling (Sanders, 2010). A recent study out of Minnesota, reports that certified veterinary technicians working in a small animal clinic may be at an increased risk of handling-related injuries if they have less than 6 years of handling experience (Nordgren et al., 2014). Since this study used certified veterinary technicians, all participants had training specific to working with animals for their position. However, not all non-veterinarian staff members receive appropriate education and training for their position, so injury rates may be higher than reported for staff members that have not attended a training program. This is also true for cats in other settings in which handling and restraint occur, such as shelter and laboratory environments, and in the pet industry such as handling for cat grooming services. Cat owners are also likely to handle and restrain their cats at home for various reasons such as medication administration and nail trims, and thus require a role model for adequate and safe handling.

3.3 Factors Influencing Decision Making in Cat Handlers

To date, no research has assessed cat handling practices used in veterinary clinics, or other settings such as animal shelters or research laboratories. However, attitudes and practices related to
animal welfare and care have been shown to be influenced by staff demographic factors, such as sex and year of graduation, with past veterinary questionnaires focusing on post-operative analgesic use (Doohoo and Doohoo, 1996; Williams et al., 2005; Hewson et al., 2001). Therefore, when considering factors that may influence cat handling practices in veterinary clinics, demographic information may be important.

Studies have suggested an increased risk of injury during livestock handling for handlers that are young (dairy farmers, cattle/livestock raisers, cattle dealers; Douphrate et al., 2009), old (cattle and horse handlers; Langley and Hunter, 2001), work long hours (livestock farm workers; Layde et al., 1996), and experience stress; elevated stress levels have also been associated with impairments in decision making and risk taking (farm workers; Elkind, 2007). In addition, handler attitude may influence handler actions, and in turn, the experiences of animals that are being handled. For example, in the dairy industry, handler attitude has been associated with dairy cow fear responses such as: flinch, step, hoof raise, and kick behaviours during milking (Hemsworth et al., 2000). This study reports that negative handler attitudes positively correlate with negative human interactions with cows, such as slapping (Hemsworth et al., 2000). To our knowledge, no one has assessed what types of cat handling techniques are used in veterinary clinics, examined the influence of cat handler attitudes on methods used for cat handling and restraint, nor the effect of these methods on cat responses. Chapter 2 of this thesis examines how cats are commonly handled in veterinary clinics in Canada and the USA, and how demographic information affects which cat handling methods are used.

Education and training are essential for all cat handlers to ensure good handling (Moffat, 2008; Hammerle et al., 2015; Anseeuw et al., 2006). Quality of care received depends on handler competence: the handler should have a good understanding of an animal’s behaviour, allowing them to perceive small changes in behaviour, adapt to those changes, and interact with the animal in a non-threatening way (Bayne, 2002). It is assumed that veterinarians and veterinary staff members that attend school for their position receive some education and training on correct handling techniques. However, the scope of coverage for handling information likely varies between training programs; at a minimum, training should
include instruction on performance of various restraints, but ideally, it should also provide an overview of current scientific research that exists on animal handling, and encourage animal care techniques that promote the animal’s welfare (Anderson, 2007). Given a lack of scientific research in this area, the current thesis aims to provide scientific evidence to recommend handling that reduces negative responses in cats.

The amount of cat handling training and assessment that veterinarians and non-veterinarians receive during their degree programs remains unexplored, and it is likely that differences exist between different training programs. One survey by Shivley et al. (2016) explored veterinary school curriculum related to animal behaviour, welfare, and ethics, among institutions located in the USA, Canada, and Europe. Results show that not all institutions offer courses dedicated to animal behaviour, or animal welfare and ethics. De Boo and Knight (2005) also assert that animal welfare science is not given adequate attention in veterinary curriculum worldwide. Thus, formal training for veterinary students may be lacking in these areas; however, instruction in handling might also be incorporated into other types of courses with a focus on clinical skills. Since animal handling incorporates knowledge in animal behaviour, welfare and ethics, it would be interesting to explore how this knowledge affects animal handling competency in practice.

One veterinary college in Australia reports that the first-year animal handling curriculum includes instruction on cat handling methods such as manual restraint, scruffing, towel wrapping, and application of a cat muzzle and cat bag (Austin et al., 2007); no specific description of methods of manual restraint is provided. This university reported that hands-on cat-handling classes were not implemented until 2006, and that implementation occurred in response to practitioners’ assessment of student handling skills (Austin et al., 2007). The recently implemented handling classes now involve hands-on practice and evaluation of students’ handling abilities (Austin, 2007). Similar information for other institutions is not readily available. Additional research is needed to examine if animal welfare and animal behaviour curriculum, in addition to practical handling instruction, may be beneficial for improving handling
competency. Moreover, cat temperament may influence cat handler decisions, and thus, this area needs to be explored and best-practice recommendations should be established for teaching purposes and to ensure cat health and welfare.

4. Low-Stress Handling Guidelines and Initiatives

4.1 Overview

In recent years, many low-stress handling guidelines have been published (Anseeuw et al., 2006; Carney et al., 2012; Hammerle et al., 2015; Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Rodan, 2010; Yin, 2009), and low-stress initiatives and educational programs for veterinarians and veterinary staff members introduced. The latter includes the American Association of Feline Practitioners (AAFP) Cat Friendly Practice® program, Dr. Sophia Yin’s Low Stress Handling® University, and the Fear-Free™ program. These guidelines and initiatives focus on perceived stress in cats when traveling to the veterinary clinic and during clinic visits. The aim of these programs is to reduce negative experiences (e.g., cat fear and aggression) and increase positive experiences for the cat, the owner, and the handler. Recommendations made by various guidelines and initiatives are practical in nature, and meant to be applied by cat owners, veterinarians, and veterinary staff members. Since there is a lack of scientific evidence showing how to reduce negative responses during veterinary visits, and during cat handling and restraint, current recommendations are largely based on common sense and anecdotal information rather than scientific evidence. A major aim of this thesis is to provide scientific evidence for examining negative cat responses during handling and restraint, in addition to using these validated parameters to assess cat responses when handled using common restraint methods.

4.2 Reducing Stress Starts at Home

Guidelines suggest that reducing fear during veterinary visits starts at home (Rodan et al., 2011). Recommendations include keeping the carrier in the cat’s living environment and leaving it openly accessible, as well feeding or playing with the cat near or inside the carrier (Rodan et al., 2011). The use
of habituation (gradual exposure to repeated stimulation to a novel stimulus), desensitization (gradual exposure to repeated stimulation to a fear-eliciting stimulus), and counter-conditioning (pairing a positive stimulus with the fear-inducing stimulus) techniques can be used to increase positive associations with the cat and the carrier. For example, habituation involves non-associative learning, wherein the cat adapts and learns not to respond to the carrier (Mills, 2009). Counter-conditioning combined with desensitization involves gradually pairing a negatively-perceived stimulus (carrier) with a positive reinforcer (treats, toys, catnip), that will change the cat’s affective state, from negative to one that is neutral, or positive (Laule et al., 2010).

The next step is transporting the cat in the carrier to the veterinary clinic. Using the same principles above, transportation can become less stressful for the owner and the cat. It is recommended for owners to practice placing cats into the carrier, and transporting the carrier to the car, slowing moving towards travel in the car to the veterinary clinic (Rodan et al., 2011). Progression of these steps and movement towards a clinic visit, should start with small changes using short sessions over time; getting the cat into the carrier, closing the pet carrier door, moving the carrier to the car, then transporting the cat to the clinic. Once the cat arrives in the clinic waiting room, it is the clinic staff that must take steps to reducing fear. Recommendations for the waiting room include high shelves for placement of cat carriers to avoid other animals and people (Lloyd, 2017), towels to cover carriers, lowering light levels, and keeping noise to a minimum (Anseeuw et al., 2016).

Cat-only examinations times and cat-only examination rooms may be helpful to minimize exposure to dogs (Rodan et al., 2011). If there is a very fearful cat, it is advised to have the cat wait in an examination room instead of the waiting room to reduce further exposure to fear-inducing stimuli (Rodan et al., 2011; Anseeuw et al., 2006). The next step is to give the cat time to come out of the carrier, and acclimate to the new environment (Moffat, 2008; Rodan et al., 2011; Rodan, 2010). If the cat does not come out on its own, guidelines suggest taking the carrier lid off, or reaching in, with or without a towel to guide the cat out (Rodan et al., 2011); it is not advised to forcefully pull the cat out, or tip the carrier
and shake it (Rodan et al., 2011; Anseeuw et al., 2006). Using treats may also help motivate the cat to exit the carrier.

Assessment of the cat’s behaviour should start when the cat enters the examination room. Anyone that handles a cat for an examination or procedure should be able to read and interpret cat behaviour. The first step is recognizing fear, then taking steps to reduce it (Herron and Shryer, 2014; Rodan et al., 2011; Rodan, 2010; Anseeuw et al., 2006; Lloyd, 2016; Yin, 2009). When approaching the cat for handling, it is advised to be flexible in the location where the handling will occur, including alternative surfaces to the examination table, such as on a chair, floor, or your lap (Rodan, 2010; Mofatt, 2008; Anseeuw et al., 2006; Rodan et al., 2011; Lloyd, 2017). Since some cats are reprimanded for being on countertops at home, some guidelines suggest that the examination table may be negatively perceived by cats and recommend that cats are not forced to stay on the table (Anseeuw et al., 2006; Rodan, 2010). Although no scientific evidence exists to support this recommendation, this is perceived as best-practice based on anecdotes and common-sense.

4.3 Common Handling Techniques: Full-body, Passive, and Minimal Restraint

The American Veterinary Medical Association’s policy on physical restraint states that the least amount of restraint should be used to minimize fear, pain, stress and suffering, while protecting both the handler and animal from harm (American Veterinary Medical Association, 2002). Techniques range from passive (where the cat is handled lightly with the least restraint possible, allowing movement of the body and limbs), minimal (restraining the cat to allow minimal movement of the body and limbs), up to full-body (holding the cat securely, immobilizing the body and legs, allowing the cat little to no movement) restraint. All of these restraint techniques are common cat handling methods used in various settings (veterinary clinics, animal shelters, research laboratories). However, no one has examined how frequently these techniques are used on cats, and whether cat demeanor and reason for handling, influence the type of restraint chosen by a handler. Generally, handling guidelines recommend starting with passive restraint or minimal restraint, which involve the least amount of restraint possible to perform an examination or
procedure (Anseeuw et al., 2006; Herron and Shryer, 2014; Rodan, 2010; Rodan et al., 2011). Based on the American Veterinary Medical Association’s policy on restraint, when it is not possible to use minimal restraint techniques on a cat, alternative methods should be used that minimize fear and stress, while also keeping the handler and the cat safe. In the past, full-body restraint was used to immobilize a cat for the sake of efficiency, and to reduce the handler’s risk of injury, with little consideration of the cat’s welfare (Moffat, 2008).

Full-body restraint is known to be fear-inducing and is widely used as a psychological stressor to model stress in various animal species (Buynitsky and Mostofsky, 2009), including cats (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993). In cats, full-body immobilization has been found to elicit struggling and vocalization (growling, hissing) responses (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988). Moreover, increases in arousal have been reported during full-body restraint in cats, such as increased heart rate (Wilkinson and Jacobs, 1988), plasma cortisol, and corticotropin hormones (Willemse et al., 1993). Although restraint is necessary to minimize cat movement when performing examinations and procedures and for ensuring cat and handler safety, it is important to consider the cat’s welfare during restraint. Thus, personnel should be flexible in their approach and handling techniques, respond to changes in the cat’s behaviour, and move towards a reduction in fear responses (Rodan et al., 2011; Rodan, 2010; Anseeuw et al., 2006; Herron and Shryer, 2014; Yin, 2009).

4.4 Restraint Methods Involving Immobilization: Full-body, Scruffing and Clips

Cats are commonly scruffed during handling and restraint to induce an immobilization (lack of movement) response, and to limit head movement to reduce the risk of injury to the handler. During scruffing a cat is grasped by the skin and fur at the back of the neck using one hand held in a fist. Scruffing tools such as clips, have been suggested for use on pet cats to induce immobilization. Generally, two types of clips are used for scruffing a cat: specially designed clips (example: Cat scruffier clip, Campbell pet company, Washington; Clipnosis® gentle calming clip™, Fairport Harbor, OH), or 2-inch
binder clips (Herron and Shreyer, 2014; Pozza et al., 2008; Nuti et al., 2016). Clips perform the same function as scruffing, with two clips applied to the back of the neck, grasping the cat’s skin and fur, where scruffing would be performed. It has been suggested that clips may be preferable over scruffing, since they provide a hands-free method of restraint (Herron and Shreyer, 2014). However, no research has examined how often scruffing and clips are used on cats in veterinary clinics, animal shelters, or laboratory settings.

Immobility responses are hypothesized as being functional, with cats naturally showing this response when held by the scruff under three conditions: 1) in young offspring during carrying by their mother, 2) during mating (Hart and Hart, 2014; Miranda et al., 2006), and 3) during attack by a predator to reduce continued attack (Monassi et al. 1990). Consistent pressure at the back of the neck has been found to produce a partial immobilization response called the dorsal immobility reflex, and this reflex has been assessed in a variety of laboratory animal species, including cats (rats: Meyer, 1990; mice: Miranda et al., 2006, Fleischmann and Urca, 1988,1992; gerbils: de la Cruz and Junquera,1993; rabbits: Carli et al., 1984; cats: Nuti et al., 2016, Pozza et al., 2008). Only young kittens, and not adult cats, are carried by queens using the scruff, and studies with rodents suggest that the immobilization response might decline with age. However, it is thought that this response also occurs in cats during mating when the male cat grips the neck of the female during copulation (Hart and Hart, 2014), so it is possible that the response persists into adulthood in this species. However, no scientific research exists that indicates valence (positive or negative) of the experience caused by the dorsal immobility reflex in cats, or has assessed cat responses during scruffing or clip restraint using validated indicators of negative cat responses.

The dorsal immobility reflex is also thought to be associated with de-sensitization from external stimuli (Pozza et al., 2008). For example, studies in rodents suggest that an anti-nociception response results with the use of clips (Carli et al., 1984; Monassi et al., 1999; Fleischmann and Urca, 1988). One study assessing mice found that neck clamps elicited anti-nociception during a tonic pain test (intraperitoneal administration of acetic acid), with mice showing reduced behavioural signs of pain such
as writhes in response to this visceral pain (Miranda et al., 2006). However, different stimuli produce different types of pain, that vary in sensitivity to different types of analgesics (Carli et al., 1984), therefore broad desensitization cannot be assumed. For example, pain induced by a formalin test (persistent pain) versus noxious heat to induce a withdrawal reflex, are differentially affected by the same analgesia (Carli et al., 1984). Thus, although there is evidence to suggest anti-nociception may result from the dorsal immobility reflex, there are complex and unexplored mechanisms involved which may differentially affect this response across differing species and situations (Carli et al., 1984).

The use of clips and scruffing on pet cats is contentious, with guidelines varying in scruff and clip recommendations, all of which are based on anecdotal information. Some recommend against their use altogether (Anseeuw et al., 2006; Hammerle et al., 2015; Rodan, 2010), with authors suggesting that use of scruffing on low-arousal cats is inappropriate (Hammerle et al., 2015), and that by avoiding scruff restraint, handling will be easier and keep the cat calmer (Rodan, 2010). Other guidelines conditionally recommend scruffing and scruffing tools for use on a case-by-case basis on cats that are not overly reactive (e.g., do not struggle or vocalize) during restraint (Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Yin, 2009). Rodan et al. (2011) gives no clear recommendation of whether scruffing and clips should be used on cats, and instead provides unclear guidance. The authors suggest that scruffing should not be used routinely, and instead, it should be used only when no alternative exists. Similarly, while some guidelines suggest avoiding the use of clips, others indicate they may be used under certain circumstances.

One handling guideline seems to recommend the use of clips over manual scruffing; suggesting that clips provide stronger, more consistent, and evenly distributed pressure than manual scruffing, and that scruffing does not provide the same behavioural calming as clips (Herron and Shreyer, 2014). However, only two studies have examined behavioural and physiological responses of cats to clips. Both studies used Likert scales to examine cat responses to clips, with a range of -3 (arousal vocalization, attempts to remove clips), to 0 (no response), to +3 (behavioural inhibition). A Likert scale positive score
indicates a cat went into spontaneous or manual lateral decubitus position (Pozza et al., 2008; Nuti et al., 2016). Nuti et al. (2016) found that 81.5% of cats showed a positive score with clips, while Pozza et al. (2016) found that 92% cats showed a positive Likert response; thus, based on these subjective scores the majority of pet cats in clinic experience behavioural inhibition with the use of clips. However, no indication was given in regard to the cat’s affective state during clipping.

Only one study has compared responses between cats restrained with clips and scruffing (Nuti et al., 2016), although the authors did not validate responses used to assess cat responses during handling. The study found an increase in physiological parameters (heart rate and pupil dilation) during scruff in comparison to clip restraint (Nuti et al., 2016). This suggests greater sympathetic activation during scruffing, and sympathetic activation has been previously associated with fear responses (Kreibig, 2010). However, physiological responses do not provide information on valence (positive or negative) of a stimulus, and thus are not good indicators of affective state without evidence that indicates valence.

Assessment of the methods used to examine cat responses by Nuti and colleagues (2016) suggests that heart rate was assessed objectively by counting the number of beats per minute; however observer bias may have existed with the subjective assessment method that was used for pupil dilation assessment. Pupil dilation was assessed using subjective scores on a 3-point scale (miosis, mydriasis, stable), and no blinding to treatment was present during assessment. In addition, cats were placed into treatment groups based on owner consent; if no consent was provided by the owner for placement into the clip group, it was placed into the scruff group. Since cats did not undergo a demeanor assessment, or assessment of interactions with the veterinarian, it is possible that some bias existed in the clip group. If an owner thinks their cat is anxious or fearful, responds negatively to handling, or has had a negative experience with scruffing in the past, this may lead to biased treatment groups. For example, if the owner knows the cat does not like to be handled, they may be more likely to decline the use of clips, resulting in the scruff group having more stressed cats than the clip group. In general, the indicators measured were not specific...
to valence, thus more research is needed to determine whether cats respond negatively to these restraint methods, with proper control groups for comparison.

4.5 Handling Tools

When higher levels of restraint are required for control or safety, alternative restraint methods have been recommended, including loose towels to drape over the cat, and towel wraps (Anseeuw et al., 2006; Hammerle et al., 2005; Moffat, 2008; Herron and Shryer, 2014; Yin, 2009). It has been suggested that cats show increased attempts to hide when exposed to stressors (Carlstead et al., 1993). Furthermore, reductions in various indicators of stress have been observed in shelter cats that have been provided with a hiding box in their home cage (Gourkow and Fraser, 2006; Kry and Casey, 2007; Rochlitz et al., 1998; Vinke et al., 2014), suggesting that opportunities to hide can reduce stress levels. Use of loose towels and towel wraps may also allow cats to feel hidden, and if so this would correspond with current guidelines that fear-reducing tools should be used. However, no research has examined whether loose towels and various types of towel wraps, reduce negative responses in cats during handling.

When using towels for restraint, it is advised to wrap the cat securely, but not too tightly, as the intent is to reduce fear levels (Yin, 2009). There are generally two main types of towel wraps: 1) head-in towel wraps, and 2) head-out towel wraps. Head-in towel wraps allow a handler to keep the cat’s head covered and away from the handler, allowing examination or procedures performed on the cat’s body. Head-out towel wraps allow the cat’s legs and body to be wrapped up, allowing the handler access to the cat’s head and neck for examination or procedures. In addition to these wraps, towels can also be rolled or folded, and used as tools for handling: for example, towels can be rolled up length-wise and placed under a cat’s chin, or around the sides of the cat’s body, for use during blood collection (Yin, 2009). Although this is recommended for use, no research has examined efficacy of these types of tools, or the effects on cat welfare.

Some guidelines suggest that cat squeeze boxes (a wire or plastic box that a cat is placed into which holds the cat firmly between the sides of the box), and cat bags (usually made of nylon or
polyester; a cat’s body and legs fit securely into bag, with the head and neck exposed,) may have a calming effect on cats (Yin, 2009; Hammerle et al., 2015). Handlers may find these methods useful because they immobilize a cat for examinations and procedures (Hammerle et al., 2015). However, some cats may become fearful and freeze, resulting in negative affect. Thus, guidelines caution that these methods may not be suitable for cats eliciting this type of response (Yin, 2009; Hammerle et al., 2015), and others suggest that placement of cats into a cat bag may be stressful in itself (Rodan et al., 2011). However, these guidelines are based on anecdotes and little scientific evidence exists to support these recommendations. Previous studies have used cat bags with a large elastic around the outside to induce sympathetic activation (increased heart rate and plasma norepinephrine; Abercrombie and Jacobs, 1987; Wilkinson and Jacobs, 1988) when studying stress responses. These studies report that all cats showed some vocalizations and struggling behaviour during a 15-minute restraint period. Restraint with cat bags in clinic does not generally involve placement of an elastic band around the cat when it is secured into the bag, but the available evidence suggests that cat bags may be negatively perceived by some cats. Further research is needed to examine if cat welfare is compromised by using cat bags for restraint.

Compression garments, such as the Thundershirt®, are an alternative tool meant to reduce struggling through calming based on application of constant pressure to the animal (Lloyd, 2017; Lloyd and Roe, 2014). These tools are placed on an animal like a t-shirt would be, and are not intended to actually restrain or immobilize the animal. This pressure-based technique has been used in animals and humans to help reduce stress and anxiety (Grandin, 1992; Diego and Field, 2009). While this technique has mainly been applied to farm animal species (ewes: Grandin et al., 1989; cattle: Grandin, 1992), it has recently been applied to dogs with thunderstorm phobia or separation anxiety (King et al., 2014). One study assessing dogs with separation anxiety found that wearing a pressure shirt led to a smaller increase in heart rate when left alone in a kennel, in comparison to those not wearing one (King et al., 2014). However, it is possible that pressure shirts are uncomfortable for animals, resulting in reduced movement, and a corresponding reduction in heart rate occurring as an artifact. Further research is needed to assess
animal affective state during the use of pressure shirts, in addition to examination of this tool for use in pet cats during examinations and procedures.

Muzzles are another handling tool commonly used in veterinary clinics with cats; they keep a cat’s muzzle closed to prevent biting, and some also cover the eyes. Some guidelines have suggested that cat muzzles which cover the eyes may reduce stress by minimizing visual stimuli during handling (Herron and Shyrer, 2014; Rodan et al., 2011; Moffatt, 2008; Yin, 2009), while others recommend this restraint is rarely needed and may result in fear-induced freezing (Anseeuw et al., 2006). Research in cattle suggests that reducing an animal’s visual perception results in a calming effect during movement through a handling system (Grandin, 1998), and that blindfolding during vaccination and ear tagging results in less struggling behaviour (Mitchell et al., 2004). Moreover, restraining dairy cows in a dark box has been shown to reduce plasma cortisol levels in comparison to a squeeze chute (Lay et al., 1992). However, no research has examined cat responses and cat welfare during muzzling.

Use of leather gloves to prevent scratches and bites during restraint is generally not recommended unless absolutely necessary because it is thought they might induce fear and stress (Mofatt, 2008; Rodan et al., 2011; Anseeuw et al., 2006). Yin (2009) and Mofatt (2008) do not recommend gloves for handling cats at all, with anecdotes suggesting gloves do not decrease fear behaviours, such as struggling (Yin, 2009). It is reasonable to hypothesize that gloves might cause negative responses in cats based on the following: 1) gloves are not generally cleaned between patients and may carry other animal odours (Mofatt, 2008; Rodan et al., 2011; Anseeuw et al., 2006), and 2) they are large, thick, and bulky, which can make handling more difficult and require increased force (Mofatt, 2008; Rodan et al., 2011; Anseeuw et al., 2006).

4.6 Chemical Restraint

Chemical restraint involves use of one or more pharmaceutical agents with a sedative or anxiolytic effect in order to reduce arousal levels and immobilize an animal during handling. Chemical restraint is used to help increase safety and reduce stress levels for the handler, the cat, and the owner.
(Llyod, 2017; Hammerle et al., 2015; Herron and Shryer, 2014; Rodan et al., 2011). For maximum
efficacy, it is recommended to deliver the medications before travelling to the clinic since maximum
effect is achieved when the animal is not overly aroused at the time of delivery (Llyod, 2017; Herron and
Shryer, 2014). Many medications are recommended for chemical restraint by handling guidelines (e.g.,
benzodiazepines, opioids, ketamine, combination therapies), but little research has assessed whether these
medications reduce fear and stress in cats during routine veterinary visits. Two studies have been
completed to examine use of trazodone hydrochloride (Stevens et al., 2016) and gabapentin (van Haaften
et al., 2017), with both showing a reduction in behavioural indicators of stress (vocalizations, struggling)
during travel to the veterinary clinic, and during veterinary examination. However, more research is
needed to examine whether the various stages of chemical restraint, including induction and recovery, are
negative for cats, especially during procedures requiring increased restraint (e.g., blood or urine
collection).

4.7 Feline Facial Pheromones

Synthetic feline facial pheromones are commonly recommended for use in veterinary clinics to
reduce stress in examination rooms (Moffat, 2008; Llyod, 2017; Herron and Shyrer, 2014; Rodan et al.,
2011). Various types of cat pheromones have been identified, including those thought to be associated
with marking territories, and with sexual reproduction for inducing or facilitating oestrus in female cats
(Bland, 1979). In recent years there has been increased attention regarding the use of a variety of
pheromone products for cats (example: feline check gland F3 pheramone: Feliway, Ceva Sante Animale,
France; Feline facial pheromone F4, Felifriend, Ceva Sante Animale, France). These products have been
suggested to help reduce stress in veterinary clinics (Conti et al., 2017; Kronen et al., 2006; Griffith et al.,
2000), at home (Conti et al., 2017; Gunn-Moore and Cameron, 2004), and in animal shelter environments
(Chadwin et al., 2017). However, a recent meta-analysis of the existing literature suggests there is
insufficient evidence to recommend the use of feline facial pheromones to calm cats during visits to the
veterinary clinic (Frank et al., 2010); based on existing studies, it does not appear to reduce struggling and
other stress-related responses during handling in the veterinary clinic (Kronen et al., 2006; Conti et al., 2017). One guideline states that although there is a lack of quality evidence to support the use of feline pheromones, until more evidence exists, there are no adverse effects with continued use of these pheromones in clinic (Llyod, 2017).

4.8 Positive Handling

It has been suggested that positively–perceived handling techniques should be used to help calm cats during handling (Rodan, 2010). One recommendation by Rodan (2010) is massaging the cat’s head, cheeks, and chin, as this may help distract and calm the cat. Gentle stroking and vocalizing by a handler has been suggested to decrease behaviours such as hiding, freezing, crawling, startle and avoidance behaviour towards humans, in cats adapting to the shelter environment (Gourkow et al., 2014). Another study by Ellis and colleagues (2015) examined cat responses to stroking of various body regions, including areas associated with allo-grooming/rubbing where scent glands are present, when performed by a familiar (cat’s owner) and unfamiliar person. The results suggest that stroking in the caudal region was associated with an increase in responses such as back/flat ears, lip licking, and biting in comparison to stroking of other body areas (e.g., ears, and peri-oral region of the head) when handled by the unfamiliar and familiar person; however, indicators assessed were not validated as negative cat responses during stroking. The authors recommend that cats should be stroked around the ears and peri-oral region of the head for a positive cat-human interaction. This finding supports recent handling recommendations that involve stroking of the cat’s head. Rodan et al. (2010), and Yin (2009) both recommend holding a cat’s head using the three middle fingers placed on top of the head between the ears, with the thumb and pinkie fingers controlling the cat’s head, and then stroking the top of the cat’s head (Rodan, 2010; Yin, 2009). In addition, Anseeuw et al. (2006) suggests that massaging a cat’s head, neck and shoulders may be positive for the cat during handling for examination.

In addition to positive interactions with humans, treats, toys or catnip can also be used for positive distraction, re-direction, reward, and counter-conditioning throughout the cat’s time in the
examination room. Use of treats is suggested to lead to positive experiences for the cat (Anseeuw et al., 2006; Hammerle et al., 2015; Herron and Shreyer, 2014; Moffatt, 2008; Rodan et al., 2011; Yin, 2009; Westlund, 2015). Ingestion of palatable food is pleasurable (Fraser and Duncan, 1998), and it has been suggested that receiving a food reward during handling will help reinforce good behaviour to create a more positive experience for the cat, the cat owner, and the handler (Hetts et al., 2004). While some staff members may be wary of providing treats due to concerns with over-weight cats, gastro-intestinal upset, and concerns about the cat having to undergo sedation or anesthesia, a cost-benefit analysis around these concerns can be assessed for individual patients (Westlund, 2015).

5. Influence of Cat Temperament and Familiarity of the Handler

Cat interactions with a handler are influenced by many factors including previous handling experiences by the cat (Grandin and Shivelly, 2015; Reisner et al., 1994), genetics (kitten paternity; Reisner et al., 1994), and a cat’s early socialization experience (critical kitten socialization period is 2-7 weeks of age; Karsh and Turner, 1988). During the socialization period, the number of people that handle the kitten can influence how it responds to handling by unfamiliar and familiar people (Karsh and Turner, 1988; Collard, 1967). Karsh and Turner (1988) report that kittens handled by multiple people showed less fear towards unfamiliar people than kittens handled by one person. Moreover, one study compared laboratory cats handled by a familiar versus an unfamiliar handler, and found an increase in struggling behaviour when cats were handled by the unfamiliar person (Lockhart et al., 2013). McCune (1995) suggests cats show a general lack of response towards an unfamiliar versus familiar person, since the stranger may pose a threat to the cat, and unresponsiveness is one way cats respond to a threatening stimulus (McCune, 1995; Adamec and Stark-Adamec, 1989).

Friendliness also appears to be influenced by genetics. One study found that cats with friendly fathers were more likely to approach and show a relaxed posture during interactions with a familiar person, and less likely to show defensive behaviours (i.e., hiss, hide, crouched posture) when interacting
with an unfamiliar person (McCune, 1995). Reisner et al. (1994) examined the effect of genetics and kitten socialization experiences on friendliness to a familiar person and responses to restraint from 4 weeks to 20 weeks of age. Friendliness was examined using kitten approach behaviour and interactions with a person sitting in a chair, and restraint consisted of placing the cat in dorsal recumbency (at 8 weeks of age) and sternal recumbency (> 8 weeks of age), while performing venipuncture. The results suggest that genetics (paternal influence and breed) may have a greater effect than early socialization on friendliness and restraint responses.

Although most studies examining friendliness towards people have used laboratory cats, Lowe and Bradshaw (1992), examined socialization and handling by an unfamiliar person in pet cats, a cat’s home environment. The results suggest an age effect; kittens at 4 months of age that had received more handling experience during socialization showed more escape attempts than those with less handling experience, but this trend was reversed at 2 months of age. The authors hypothesize that by 4 months of age, kittens that received less handling were freezing when handled by an unfamiliar person, while the other group was becoming more active in the same situation. Overall, this research suggests that genetics and early socialization influence temperament development and responses to interactions with familiar and unfamiliar people. However, it is also likely that these responses are influenced by other factors, including the handling environment, the home environment, and other owner-related factors such as personality traits (Kotrschal et al., 2014), and these factors require further exploration in future research.

6. Thesis Rationale

There is a lack of scientific literature to support recommendations for how cats should be handled and restrained, and as a result, current guidelines are largely based on common sense and anecdotal reports. To improve cat handling practices, further research in a number of different areas is necessary. First, it is important to determine how cats are commonly handled in veterinary clinics, which
will allow us to better understand which practices are routinely used and require further investigation to assess whether improvements are necessary.

Second, scientific evidence is needed to support handling recommendations that improve cat welfare. One major barrier to research in this area is a lack of validated methodologies for examining cat responses to handling and restraint. Thus, research is needed to develop validated methodologies to identify negative cat responses to handling, so that they can be used to examine commonly used cat handling techniques to determine which ones minimize negative responses. Given that scruffing and clip restraint are particularly contentious, with guidelines being divided in terms of recommendations for use of these methods, research assessing cat responses to these restraint techniques is particularly important.

The overall objectives of this thesis were as follows:

1. To determine common cat handling and restraint practices used in veterinary clinics by veterinarians and non-veterinary staff members, throughout Canada and the USA, and to describe factors that influence use of both minimal and heavy restraint (Chapter 2);
2. To develop and validate methodologies for use in examining cat aversion responses to restraint (Chapter 3);
3. To validate various behavioural and physiological measures for use in assessing response differences during restraint in cats. Response differences were assessed when placing cats into restraint, during restraint, and post-restraint (Chapter 4);
4. To use the validated methodologies developed and validated in Objectives 2 and 3, to examine negative cat responses to two contentious restraint techniques: scruffing and clips (Chapter 5).
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Chapter 2: A Cross-Sectional Survey of Cat Handling Practices in Veterinary Clinics Throughout Canada and the United States

Abstract

During handling and restraint for routine examinations and procedures, cats may show signs of fear and aggression which may lead to handling challenges. Current cat handling guidelines recommend use of low-stress handling techniques that minimize fear, although it is unknown what type of cat handling and restraint practices are being used in veterinary clinics. Thus, the current study aimed to: 1) describe cat handling and restraint practices, and 2) describe factors that may influence use of various restraint methods, by veterinarians and veterinary staff members in veterinary clinics throughout Canada and the USA. An online cross-sectional questionnaire was distributed to veterinarians and veterinary staff members that handle cats in veterinary clinics in Canada and the USA. The questionnaire including questions pertaining to demographics, general handling practices, and frequency of handling techniques used during routine examinations and procedures on calm, fearful and aggressive cats. Logistic regressions were performed to examine associations between participant demographics and use of minimal restraint, and full-body with scruff restraint. Respondents (veterinarians n=310, non-veterinary staff members n=944) report that cats of all demeanor types are handled using full-body with scruff for examinations and procedures, with increased use on fearful and aggressive cats. The following demographics were associated with less frequent use of full-body with scruff restraint during examinations of fearful (F) and aggressive (A) cats: works at an American Association of Feline Practitioners certified Cat Friendly Practice® versus not (F, P=0.0001; A, P=0.0001), works in Canada versus the USA (F, P<0.0001; A, ns), a veterinarian versus a non-veterinarian (F, P<0.0001; A, ns), and a non-veterinarian who graduated in 2005 or earlier versus a non-veterinarian that did not graduate from a formal training program (F, P<0.0001; A, P<0.0001). Participants’ reports suggest that cats of all
demeanor types are handled using full-body with scruff. Wider adoption of low-stress handling techniques are recommended to ensure health and welfare during veterinary visits.
1. Introduction

In recent years, handling and restraint techniques used on cats in veterinary clinics have garnered more attention. Visits to the veterinary clinic appear to result in negative experiences for some cats and their owners (Hewson, 2014a; Hewson 2014b; Mariti et al., 2016; Volk et al., 2011a; Volk et al., 2011b; Volk et al., 2014), which leads to reduced willingness to bring their cat back for routine health visits (Volk et al., 2011a; Volk et al., 2011b; Volk et al., 2014). One study carried out in Italy by Mariti et al. (2016) reports that 85% of cat owners surveyed reported impairment in their cat’s welfare while on the examination table during veterinary visits. The study also suggests that cat owners’ assessment of pet care at the veterinary clinic is based on a veterinarian’s ability to handle their cat, with reports that rough or careless handling resulted in negative impressions of their veterinarian. Moreover, in a questionnaire conducted in the USA by Volk et al. (2011b), veterinarians report that pet owners are delaying bringing injured and sick pets into the veterinary clinic due to past experiences. This is concerning, given that routine veterinary care helps to maintain health and welfare over a cat’s lifetime (Volk et al., 2011a, Volk et al., 2014; Osborne 2010). One way to reduce negative associations with veterinary visits, is to provide positive experiences and reduced stress during routine handling for examinations and procedures.

During routine handling and restraint, cat fear and aggression may result in handling difficulties and lead to incomplete examinations with the potential for inaccurate diagnoses and treatments (Glardon et al., 2010; Mariti et al., 2016). Appropriate handling and restraint is key for preventing animal bites and scratches to veterinarians and veterinary staff members (Gibbins and MacMahon, 2015). Cat bites and scratches are one of the most common forms of animal-related injuries that occur in small animal veterinary clinics (Fowler et al., 2015; Jeyaretnam and Jones, 2000; Gibbins and MacMahon, 2015; Nordgren et al., 2014; Nienhaus et al., 2005), with hand and arm injuries occurring during restraint and treatment of cats in examination and treatment rooms (Gibbins and MacMahon, 2015; Nordgren et al., 2014).
Many cat handling guidelines (Anseeuw et al., 2006; Carney et al., 2012; Hammer et al., 2015; Herron and Shreyer, 2014; Lloyd, 2017; Moffat, 2008; Rodan et al., 2011; Rodan, 2010; Yin, 2009) and low-stress initiatives exist, such as the American Association of Feline Practitioners (AAFP) Cat Friendly Practice® program, Dr. Sophia Yin’s Low Stress Handling® University, and the Fear-Free™ program. These programs aim to minimize fear and stress in cats during veterinary visits, thus reducing the potential for aggressive behaviour, and encouraging positive experiences for the animal, the owner, and the handler. Handling recommendations provided by these guidelines and programs include using passive and minimal restraint techniques when possible. Some guidelines recommend the use of full-body restraint on a case-by-case basis (Herron and Shryer, 2014; Lloyd, 2017; Yin, 2009), while others suggest that alternative restraint methods should be used altogether (Anseeuw et al., 2006; Hammerle et al., 2015; Rodan, 2010). One guideline states that manual restraint techniques such as full-body immobilization and scruffing are inappropriate (Hammerle et al., 2015). Guidelines generally suggest using alternatives to manual full-body and scruff restraint techniques, such as towel wraps, and Lloyd (2017) suggests using the minimal restraint necessary to safely perform an examination or procedure. Other recommendations to help improve a cat’s experience include performing handling where the cat is most comfortable (not just the examination table), offering opportunities for positive reinforcement and distraction (e.g., providing treats), using chemical restraint when necessary, and providing clients with information on ways to reduce stress for future visits. Implementation of these recommendations is thought to be important for improving the experience of the cat and owner, and improving the client-veterinarian relationship. Moreover, this will help with ease of examination, diagnoses, and treatments, and increasing owner willingness to bring their cat back for routine veterinary care. Whether these recommendations are widely implemented or not, remains unexplored.

The current study explored current cat handling practices commonly used by veterinarians and non-veterinarian staff members on cats with three types of demeanors: calm fearful, or aggressive, during routine examinations and procedures in veterinary clinics throughout Canada and the USA.
In past veterinary health questionnaires, participant demographic factors have been found to influence attitudes and practices related to animal care and welfare. For example, post-operative analgesic use by Canadian veterinarians has shown to be influenced by a veterinarian’s sex, year of graduation, and whether or not a clinic employed veterinary technicians (Doohoo and Doohoo, 1996; Williams et al., 2005; Hewson et al., 2001). Therefore, in the current study, participant demographics such as current position (practicing veterinarian, veterinary technologist, veterinary assistant, other), sex, school attended and year of graduation, were included as putative factors which may influence how a participant handles cats in clinics. Specifically, we assessed whether individual or clinic demographics influenced techniques used to restrain cats for examinations and procedures.

2. Materials and Methods

2.1 Questionnaire

A cross-sectional online questionnaire was distributed throughout Canada and the USA, to examine general cat handling practices used by veterinarians and non-veterinarian staff members. The study protocol was reviewed and approved by the University of Guelph Research Ethics Board.

The questionnaire was comprised of the following four sections: 1) participant demographics (7 questions), 2) general handling (9 questions), 3) frequency-use ratings for 15 handling techniques (Appendix A; 6 questions), and 4) location of handling in the exam room (1 question). The questionnaire used the term ‘secure restraint’ as a synonym for full-body restraint. The term secure restraint will be used in Chapter 2 figures, but will be referred to as full-body restraint throughout the text for thesis consistency.

Demographic questions included information on current position in the veterinary clinic, if school was attended for the position, year of graduation, sex and province/state. General handling questions included information such as: a cats-only examination room in the clinic, average number of cats handled per day, standard protocol for approaching and handling aggressive cats at their clinic, and frequencies of
the following: a non-veterinarian performing a pre-exam, how often cats are handled by the participant (example: daily, weekly), provision of treats during handling, provision of information to clients on how to reduce stress for future visits, and use of chemical restraint on fearful and aggressive cats. In addition, participants were asked if their main clinic of work was an AAFP Cat Friendly Practice®, as this was the only handling certification available at the time of the study. The third section looked at frequency-ratings for use of 15 handling techniques on calm (relaxed, no signs of aggression or fear-related behaviours), fearful (immobile, showing fear-related behaviours such as lowered posture, dilated pupils and flattened ears, without attempting to bite and/or scratch), or aggressive (showing fear and/or escape-related behaviours while attempting to bite and/or scratch) cats, during routine examinations (assessment of the cat’s skin, coat and body condition, heart rate, temperature, respiratory rate, eyes, ears, mouth and teeth) and procedures (nail trim, blood collection, urine collection). Most handling techniques had an accompanying picture beside its description. Handling technique pictures were from anonymous providers as well as the AAFP. The last section asked participants the frequency of using various locations within the examination room (floor, examination table, cat’s carrier, scale, chair), when handling a calm, fearful, or aggressive cat.

The questionnaire was pre-tested on a sample (n=4) of veterinarians in Guelph, Ontario Canada, to assess clarity and face validity. Feedback was received and used to refine the questions to create the final questionnaire.

The study population consisted of licensed veterinarians, and non-veterinarian staff members that handle companion cats, and currently work in veterinary clinics in Canada or the USA. Questionnaire participation was anonymous and completely voluntary, and consent was received online before the participant could access the survey.

The questionnaire was available online using Qualtrics® survey software (Qualtrics® Software Company, Provo, Utah, USA) from July 27th – December 29th, 2015. Snowball sampling was initiated through email invitations to participate along with an advertisement containing a link to the questionnaire,
with a request to distribute the advertisement to their member list, social media accounts, and associated websites. Invitations were emailed to all of the Canadian and American Veterinary Medical Association bodies, all of the Canadian and American veterinary technologists and technician organizations, in addition to the American Association of Veterinary Clinicians, Veterinary News Network, Veterinary Hospital Managers Association, Cat Healthy, American Board of Veterinary Practitioners, American Veterinary Society of Animal Behaviour, American Animal Hospital Association, AAFP, and the Association of Shelter Veterinarians. The advertisement was also posted on the Ontario Veterinary College’s social media accounts, and distributed to all the Canadian and American veterinary school alumni accounts that were discoverable on Facebook (Facebook Inc., Menlo Park, California, USA).

2.2 Data Analysis

All analyses were conducted using statistical software (SAS Studio v.3.7, SAS Institute, Cary NC, USA). Responses from individuals that were not currently working as a veterinarian or veterinary staff member (n=15), did not examine or handle cats at their clinic (n=23), or did not answer any questions other than the initial demographic questions (n=27), were excluded from analyses; some respondents fit in more than one exclusion category. The final sample population for use in analyses was 1254.

Descriptive statistics (frequencies and percentages) were calculated using participant responses. For the frequency-use ratings for the 15 handling techniques, responses were reduced to create binary outcomes. A ‘use’ category was created by combining always, often and sometimes responses, and a ‘not used’ category was created by combining rarely and never responses. The ‘use’ and ‘not used’ categories created a binary outcome variable to examine factors that may influence the use of: 1) minimal restraint, and 2) full-body with scruff restraint, on fearful and aggressive cats during examinations and procedures. These two restraint techniques were chosen because they represent a contrasting degree of restraint. Use of these restraint techniques on fearful and aggressive cats were chosen based on our prediction that cats with these demeanors were more likely to be held with both restraint types, in comparison to calm cats.
Logistic regression models were used to determine the association between: 1) minimal restraint used on a) fearful and b) aggressive cats, for examinations and procedures, and 2) full-body with scruff used on a) fearful and b) aggressive cats, for examinations and procedures. Since all veterinarians had attended school, but non-veterinarians might not have, the veterinarian and non-veterinarian responses were initially analyzed separately. However, to allow assessment of differences between veterinarians and non-veterinarians, a secondary analysis combined all participant responses but did not include questions about training. Thus, separate models were built for each of the following participant group responses: 1) veterinarians, 2) non-veterinarian staff, and 3) all participants combined (veterinarian and non-veterinarian staff). Explanatory variables that were included in all models were the following: sex (female, male), AAFP practice (yes, no), number of cats handled per day (0-3, 4-6, ≥ 7), and country (Canada, USA). School attended (yes, no) and graduation year (2006 – 2015, ≤ 2005, none) were added to non-veterinarian staff models, graduation year (2006 – 2015, ≤ 2005, no response) was added to veterinarian models, and position in clinic (veterinarian, non-veterinarian) was added to combined models.

All variables included in the model were first examined using univariate analysis. Models were built using a backward elimination process whereby all of the explanatory variables were included in the model and then removed one at a time if P ≥ 0.05. Given the logistic models were created exclusively using categorical variables, interaction variables were tested and used to assess model fit.

3. Results

3.1 Descriptive Statistics

The majority of respondents were females, veterinary technicians, and those working in the USA. About one quarter of respondents were veterinarians. See Table 2.1 for a full report of the demographic results. Most respondents reported that they handle cats on a daily basis, but do not work at an AAFP Cat Friendly Practice®, and do not have separate examination rooms for use with cats only (Table 2.2).
About half of respondents reported that their clinic has a protocol for approaching and handling aggressive cats. Responses about the frequency of use for various general handling strategies were variable (Table 2.3); Almost half of all respondents reported that they rarely use chemical restraint on fearful cats, but sometimes use chemical restraint on aggressive cats. Moreover, about half of participants reported that they always record relevant details about cat responses to handling in the cat’s records, and only one quarter of respondents regularly offer treats during handling. When asked about frequency of use for different examination locations, most respondents reported that they rarely examine cats on a person’s lap, the floor, or an alternative surface, and always or often on the examination room table, regardless of demeanor (Table 2.4). However, most reported that they often examine cats in the bottom of the carrier.

The reported frequency of use of the 15 different handling techniques varied depending on whether performed during examinations or procedures, and whether the cat was calm (Figure 2.1), fearful (Figure 2.2), or aggressive (Figure 2.3). Respondent reports indicate that calm cats are generally held using passive, minimal and loose towel techniques; however full-body restraint techniques are still used for calm cats. Similarly, handling of fearful cats is performed using a variety of restraint techniques such as passive, minimal, and use of loose towels, but respondents also reported using full-body restraint techniques, scruffing, facemasks and towel wraps (burrito and reverse burrito). When handling aggressive cats, generally full-body restraint techniques are used, as well as towel wraps, gloves, and face masks.

3.2 Logistic Regression Results

Logistic regression models for veterinarian-only (Table 2.5), non-veterinarian staff (Table 2.6), and veterinarians combined with non-veterinary staff (Table 2.7), are outlined in tables illustrating the Odds Ratios (OR). In total, results are presented for 24 models that assessed demographic contributors for each of these participant categories for fearful and aggressive cats, using minimal and full-body with scruff restraint, during examinations and procedures. For models assessing fearful cats during minimal restraint, results are presented in the text only.
3.2.1 Veterinarian-Only Results

No factors measured were associated with the use of minimal restraint on fearful cats during examinations (N=232) or procedures (N=207). Results for all other models are presented in Table 2.5

3.2.2 Non-Veterinarian Results

Non-veterinarians that graduated between 2006 - 2015 were 1.25 (95% CI: 0.74, 2.13; P=0.012; N=525) times more likely to use minimal restraint on fearful cats in comparison to those that did not graduate from a related professional program. No factors measured were associated with the use of minimal restraint on fearful cats during examinations (N=646) in this group of participants, and all other models are presented in Table 2.6.

3.2.3 Veterinarian and Non-Veterinarian Combined Results

During examinations (N=892), veterinarians were 0.58 (95% CI: 0.36, 0.96; P= 0.031) times less likely to use minimal restraint when examining a fearful cat, than non-veterinarian staff members. However, during procedures (N=747) veterinarians were 1.57 (95% CI: 1.05, 2.42; P= 0.034) times more likely to use minimal restraint to handle a fearful cat in comparison to non-veterinarian staff members. Results for all other models are presented in Table 2.7

4. Discussion

Overall, trends in the descriptive results suggest that the use of different handling techniques depends on cat demeanor and reason for handling. Most respondents indicated use of passive and minimal restraint when handling calm cats for examinations and procedures, and use of passive, minimal and loose towel techniques when handling fearful cats for examinations. However, some respondents indicated use of techniques involving manual full-body immobilization, such as full-body with scruff restraint, when handling calm and fearful cats, with a relatively high proportion of respondents using these techniques always or often for procedures. This contrasts with recent guidelines suggesting for reduced use of fear-inducing restraint techniques (Rodan et al., 2011; Rodan, 2010; Anseeuw et al., 2006; Herron and Shryer,
Full-body immobilization is used to cause a stress response in a variety of animal species, including cats, since it elicits an unconditioned fear response (Buynitsky and Mostofsky, 2009; Grandin, 1997; Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993). For example, this type of restraint has been shown to result in sympatho-adrenal activation (Abercrombie and Jacobs, 1987), as well as avoidance behaviour such as struggling (Adolphs, 2013; Archer, 1979; Moody et al., 2018). Thus, the use of full-body restraint when handling cats may lead to incomplete examinations being performed, and the possibility of inaccurate diagnoses and treatments (Glardon et al., 2010; Mariti et al., 2016), which is a cat health and welfare concern.

It has been suggested that, historically, use of higher levels of restraint was condoned in veterinary medicine to prevent injury of personnel (Rodan, 2010). However, given that full-body immobilization has been shown to increase fear in cats, using these types of techniques has the potential to increase aggressive behaviour, placing the handler and the cat at an increased risk of injury (Hammerle et al., 2015). Indeed, current cat handling guidelines suggest using passive and minimal restraint techniques to help keep cats calm, with low arousal and fear levels, reducing the risk of aggression and subsequent injury (Rodan, 2010; Rodan et al., 2011; Hammerle et al., 2015).

Given that not all cats can be handled with passive or minimal restraint, additional handling tools may be necessary to perform an examination or procedure. Loose towels and towel wraps are recommended in guidelines as handling alternatives, with the idea that towels may help keep cats calm (Hammerle et al., 2015; Moffat, 2008; Rodan et al., 2011; Yin, 2009), although there is no scientific data to support this claim. Our results show that approximately 70% of veterinarians stated that they often or sometimes use a loose towel as an alternative tool for handling. The current results suggest that towels and towel wraps are commonly used to handle calm cats during procedures, and fearful and aggressive cats during examinations and procedures. Aggressive cats are also commonly handled using gloves and cat muzzles. Gloves likely help the handler feel safer when handling aggressive cats, and it has been suggested that tools reducing visual stimuli, such as cat muzzles, may help calm animals (Herron and
However, Anseeuw et al. (2006) warns that muzzles may cause freezing behaviour in cats, which is a well-known fear response in animals (Adolphs, 2013). While the use of gloves protects a handler from injury, this tool is not recommended in some handling guidelines (Moffat, 2008; Yin, 2009). These guidelines suggest that gloves do not reduce behaviours indicative of fear, such as struggling (Yin, 2009), but no data exists to support this claim. When examining and performing procedures on cats of all demeanor types, the current results indicate that cat bags and scruffing tools are used infrequently. Further research is needed to better understand veterinarian and veterinary staff perceptions about common handling techniques, and to identify motivations behind the choice of specific handling tools and methods.

There was a large variability in responses regarding offering treats during handling. There may be wariness by some veterinary staff members to provide treats given concerns with gastro-intestinal upset, obese patients, and increased risks if the cat should undergo sedation or anesthesia (Westlund, 2015). Furthermore, cats exposed to a stressor may show reduced food intake (Stella et al., 2013; Tanaka et al., 2012), and it is likely that some cats will not consume treats when entering the examination room in a negative affective state (Mariti et al., 2016). However, many cats will consume treats and it has been argued that with common sense, owner consent, and individualized patient assessment, the use of palatable food may help create a more positive experience for the cat when used for distraction, redirection, reward, and counter-conditioning during handling (Anseeuw et al., 2006; Hammerle et al., 2015; Herron and Shryer, 2014; Moffat, 2008; Rodan et al., 2011; Yin, 2009; Westlund, 2015).

The AAFP certified cat friendly program was introduced to provide a more positive experience for cats, and help reduce stress during clinic visits. A recent study by Dawson and colleagues (2017) suggest that AAFP Cat Friendly Practice® clinics use scruffing less than non-certified clinics, which corresponds with our results for use of full-body with scruff restraint. We also found that reported use of minimal restraint was higher in AAFP Cat Friendly Practices. These findings suggest that overall, the AAFP program is leading to changes in cat handling methods. It is possible that alternative initiatives and
handling certification programs, which were not available at the time of this survey, may be providing similar impacts. It would be beneficial to repeat the current questionnaire in the future to examine the progress of these new initiatives and programs.

Overall, veterinarians and non-veterinarian staff working in Canada were less likely to use a full-body with scruff restraint technique on fearful and aggressive cats, in comparison to respondents that work in the USA. The reasons for this finding are unknown, but might reflect legal differences between the countries that potentially result in greater financial penalties in response to workplace injury in the USA. This finding might also be attributed to differences in education related to animal behaviour, welfare, and ethics across veterinary programs, leading to differences in handling practices. Although no research has compared differences in handling education in veterinary schools throughout Canada and the USA, recent research suggests that not all veterinary schools offer courses dedicated to animal behaviour, ethics and welfare, and those that do may differ in course curriculum (Shively et al., 2016; Main, 2010). More research is needed to examine how this variation in curriculum affects recent veterinarian graduates’ handling, and their ability to identify behavioural signs of fear and stress in cats.

Results show that veterinarians were more likely to use minimal restraint on aggressive cats and less likely to use full-body with scruff restraint on fearful and aggressive cats during examinations, compared to non-veterinarian staff; this result was not seen for procedures. Veterinarians often perform examinations without assistance, so it is possible that non-veterinary staff are more likely to be asked to assist with challenging cats, leading to a bias towards them reporting increased use of restraints involving immobilization. Alternatively, differences in handling practices between veterinarians and non-veterinarians may be due to differences in awareness about alternative tools that exist for handling, as well as the benefits of using minimal restraint techniques; veterinarians may be more likely to attend external continuing education opportunities than non-veterinarians. An essential component of effective handling includes the ability to identify signs of fear or stress in cats so that handling can be adapted to prevent escalated arousal levels (Hammerle et al., 2015; Herron and Shreyer, 2014; Lloyd, 2017; Moffat,
2008; Rodan et al., 2011; Rodan, 2010), and this is likely to improve with education and experience, possibly leading to increased use of lower levels of restraint. It is recommended that more effort should be made to provide relevant educational opportunities for veterinary staff, particularly non-veterinarian staff members, with a focus on recent graduates and those that did not graduate from a veterinary program, on the use and benefits of minimal restraint techniques.

There were some limitations associated with the current survey methods. First, since questionnaire dissemination used email and social media, snow-ball sampling limited responses to those with an active social media or email account, and those comfortable with online survey platforms. In the current study, only a small sample of respondents graduated before 1995, which could be due to the web-based dissemination method and survey platform used. Past literature shows that web-based and paper-based surveys are more likely to have younger respondents (Callas et al., 2010; Hirsch et al., 2013; Zuidgeest et al., 2011), although a study by Hohwü et al. (2015) suggests that older people are increasingly likely to use the internet.

Most responses were provided by females, although this was expected given that just over half of veterinarians in the USA and Canada are female (American Veterinary Medical Association, 2016; Canadian Veterinary Medical Association, 2017), a large portion of recent graduates from veterinary programs are female (Lofstedt, 2003), and a large portion of veterinary technicians are female (Norkus et al., 2016). Overall respondents also included a greater number of non-veterinarian staff members, such as veterinary technicians and veterinary assistants, in comparison to licensed veterinarians. Non-veterinarian staff members play a large role in animal handling for various animal care duties (Sanders, 2010), and thus were an important part of our target population. Survey respondents indicated daily cat handling, with most reporting that they routinely handle between 1-6 cats per day; this is important for meeting the aims of the survey given the questionnaire is focused on current cat handling practices. However, it is possible there was a sampling bias towards those with an interest in cat handling practices.
5. Conclusion

In conclusion, the current results indicate that handling calm cats is commonly performed using passive and minimal restraint techniques. However, there is still widespread usage of full-body restraint and scruff techniques, even for calm animals during examinations. Handling of fearful cats is performed using a variety of techniques, including passive, minimal, full-body, scruff, and towels, while aggressive cats are commonly handled using full-body, scruff, towel wraps, gloves, and face masks. Veterinarians, as well as non-veterinary staff that graduated in 2005 or earlier, were less likely to use full-body with scruff restraint, and other factors that were associated with a decreased likelihood of using this technique included working at an AAFP Cat Friendly Practice® or working in Canada. Continued progress towards a reduction of cat stress during veterinary visits is important to ensure the health and welfare of cats during visits to the veterinary clinic, in addition to increasing owner willingness to bring their cat back for routine health care. One major gap that exists is the lack of scientific literature to support current handling recommendations. Thus, further research is needed to examine if use of the practices results in a reduction of cat stress during handling in the veterinary clinic.
References


Table 2.1. Demographic information for veterinarians and non-veterinarian staff members participating in the questionnaire (N=1254).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position in veterinary clinic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practicing veterinarian</td>
<td>310</td>
<td>24.7</td>
</tr>
<tr>
<td>Veterinary technician/technologist</td>
<td>760</td>
<td>60.6</td>
</tr>
<tr>
<td>Veterinary assistant</td>
<td>134</td>
<td>10.7</td>
</tr>
<tr>
<td>Other</td>
<td>50</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>1254</td>
<td>100</td>
</tr>
<tr>
<td><strong>Attended school for position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>965</td>
<td>77.0</td>
</tr>
<tr>
<td>No</td>
<td>288</td>
<td>23.0</td>
</tr>
<tr>
<td>Total</td>
<td>1253</td>
<td>100</td>
</tr>
<tr>
<td><strong>Graduate year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006 - 2015</td>
<td>538</td>
<td>58.4</td>
</tr>
<tr>
<td>1996 - 2005</td>
<td>212</td>
<td>23.0</td>
</tr>
<tr>
<td>1986 - 1995</td>
<td>115</td>
<td>12.5</td>
</tr>
<tr>
<td>1976 - 1985</td>
<td>49</td>
<td>5.3</td>
</tr>
<tr>
<td>1965 - 1975</td>
<td>6</td>
<td>0.7</td>
</tr>
<tr>
<td>&lt; 1965</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>921</td>
<td>100</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1174</td>
<td>93.8</td>
</tr>
<tr>
<td>Male</td>
<td>67</td>
<td>5.4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>1251</td>
<td>100</td>
</tr>
<tr>
<td><strong>Country</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>337</td>
<td>27.8</td>
</tr>
<tr>
<td>United States</td>
<td>859</td>
<td>70.7</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>18</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>1214</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 2.2 Summary statistics for categorical questions on general handling for veterinarians and non-veterinarian staff members participating in the questionnaire (N=1254).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AAFP Cat Friendly Practice®</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>243</td>
<td>20.3</td>
</tr>
<tr>
<td>No</td>
<td>956</td>
<td>79.7</td>
</tr>
<tr>
<td>Total</td>
<td>1199</td>
<td>100</td>
</tr>
<tr>
<td><strong>Separate exam rooms for cats only</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>392</td>
<td>32.5</td>
</tr>
<tr>
<td>No</td>
<td>813</td>
<td>67.5</td>
</tr>
<tr>
<td>Total</td>
<td>1205</td>
<td>100</td>
</tr>
<tr>
<td><strong>Frequency of handling cats at your clinic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>1137</td>
<td>94.4</td>
</tr>
<tr>
<td>Weekly</td>
<td>61</td>
<td>5.1</td>
</tr>
<tr>
<td>Monthly</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>Never</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>1205</td>
<td>100</td>
</tr>
<tr>
<td><strong>Average number of cats handled per day</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>1 – 3</td>
<td>335</td>
<td>27.8</td>
</tr>
<tr>
<td>4 – 6</td>
<td>446</td>
<td>37.0</td>
</tr>
<tr>
<td>7 – 9</td>
<td>229</td>
<td>19.0</td>
</tr>
<tr>
<td>10 – 12</td>
<td>101</td>
<td>8.4</td>
</tr>
<tr>
<td>13 – 15</td>
<td>91</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>1206</td>
<td>100</td>
</tr>
<tr>
<td><strong>Clinic protocol for approaching and handling aggressive cats</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>586</td>
<td>48.7</td>
</tr>
<tr>
<td>No</td>
<td>618</td>
<td>51.3</td>
</tr>
<tr>
<td>Total</td>
<td>1204</td>
<td>100</td>
</tr>
<tr>
<td><strong>Is this protocol followed by clinic staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>517</td>
<td>88.5</td>
</tr>
<tr>
<td>No</td>
<td>67</td>
<td>11.5</td>
</tr>
<tr>
<td>Total</td>
<td>584</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 2.3 Summary statistics for frequency-scale questions on general handling for veterinarians and non-veterinarian staff members participating in the questionnaire (N=1254)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Always n</th>
<th>Often n</th>
<th>Sometimes n</th>
<th>Rarely n</th>
<th>Never n</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>Non-veterinian performs pre-exam</td>
<td>266</td>
<td>274</td>
<td>241</td>
<td>254</td>
<td>167</td>
<td>1202</td>
</tr>
<tr>
<td>(22.1)</td>
<td>(22.8)</td>
<td>(20.1)</td>
<td>(21.1)</td>
<td>(13.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offer treats during handling</td>
<td>108</td>
<td>272</td>
<td>347</td>
<td>314</td>
<td>163</td>
<td>1204</td>
</tr>
<tr>
<td>(9.0)</td>
<td>(22.6)</td>
<td>(28.8)</td>
<td>(26.1)</td>
<td>(13.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use chemical restraint before handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Fearful cat</td>
<td>10</td>
<td>58</td>
<td>330</td>
<td>529</td>
<td>264</td>
<td>1191</td>
</tr>
<tr>
<td>(0.8)</td>
<td>(4.9)</td>
<td>(27.7)</td>
<td>(44.4)</td>
<td>(22.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Aggressive cat</td>
<td>65</td>
<td>379</td>
<td>505</td>
<td>203</td>
<td>33</td>
<td>1185</td>
</tr>
<tr>
<td>(5.5)</td>
<td>(32.0)</td>
<td>(42.6)</td>
<td>(17.1)</td>
<td>(2.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When handling a difficult cat, record relevant details in their record</td>
<td>665</td>
<td>359</td>
<td>133</td>
<td>38</td>
<td>6</td>
<td>1201</td>
</tr>
<tr>
<td>(55.4)</td>
<td>(29.9)</td>
<td>(11.1)</td>
<td>(3.2)</td>
<td>(0.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information provided to clients about reducing stress for future visits</td>
<td>267</td>
<td>390</td>
<td>358</td>
<td>136</td>
<td>35</td>
<td>1186</td>
</tr>
<tr>
<td>(22.5)</td>
<td>(32.9)</td>
<td>(30.2)</td>
<td>(11.5)</td>
<td>(2.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2.4. Frequency-scale handling question summary statistics (n, %) for the location that calm, fearful, and aggressive cats are handled in the examination room.

<table>
<thead>
<tr>
<th>How often do you handle the cat on:</th>
<th>Always n (%)</th>
<th>Often n (%)</th>
<th>Sometimes n (%)</th>
<th>Rarely n (%)</th>
<th>Never n (%)</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam room floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>17 (2.2)</td>
<td>65 (8.3)</td>
<td>157 (20.1)</td>
<td>217 (27.8)</td>
<td>325 (41.6)</td>
<td>781</td>
</tr>
<tr>
<td>Fearful</td>
<td>8 (1.0)</td>
<td>43 (5.5)</td>
<td>163 (21.0)</td>
<td>188 (24.2)</td>
<td>375 (48.3)</td>
<td>777</td>
</tr>
<tr>
<td>Aggressive</td>
<td>4 (0.5)</td>
<td>28 (3.6)</td>
<td>91 (11.7)</td>
<td>167 (21.5)</td>
<td>486 (62.6)</td>
<td>776</td>
</tr>
<tr>
<td>Your lap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>18 (2.3)</td>
<td>142 (18.2)</td>
<td>224 (28.7)</td>
<td>144 (18.5)</td>
<td>252 (32.3)</td>
<td>780</td>
</tr>
<tr>
<td>Fearful</td>
<td>2 (0.3)</td>
<td>34 (4.4)</td>
<td>202 (26.1)</td>
<td>166 (21.5)</td>
<td>370 (47.8)</td>
<td>774</td>
</tr>
<tr>
<td>Aggressive</td>
<td>1 (0.1)</td>
<td>3 (0.4)</td>
<td>28 (3.61)</td>
<td>109 (14.1)</td>
<td>634 (81.8)</td>
<td>775</td>
</tr>
<tr>
<td>Bottom of carrier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(with or without towel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>23 (3.0)</td>
<td>224 (28.8)</td>
<td>316 (40.6)</td>
<td>131 (16.8)</td>
<td>84 (10.8)</td>
<td>778</td>
</tr>
<tr>
<td>Fearful</td>
<td>50 (6.4)</td>
<td>394 (50.6)</td>
<td>268 (34.5)</td>
<td>34 (4.4)</td>
<td>32 (4.1)</td>
<td>778</td>
</tr>
<tr>
<td>Aggressive</td>
<td>52 (6.7)</td>
<td>285 (36.7)</td>
<td>248 (32.0)</td>
<td>104 (13.4)</td>
<td>87 (11.2)</td>
<td>776</td>
</tr>
<tr>
<td>Exam table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>307 (39.2)</td>
<td>415 (53.0)</td>
<td>53 (6.8)</td>
<td>8 (1.0)</td>
<td>0 (0.0)</td>
<td>783</td>
</tr>
<tr>
<td>Fearful</td>
<td>179 (23.0)</td>
<td>425 (54.6)</td>
<td>158 (20.3)</td>
<td>14 (1.8)</td>
<td>2 (0.3)</td>
<td>778</td>
</tr>
<tr>
<td>Aggressive</td>
<td>177 (22.80)</td>
<td>341 (43.9)</td>
<td>187 (24.1)</td>
<td>54 (7.0)</td>
<td>18 (2.3)</td>
<td>777</td>
</tr>
<tr>
<td>Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>100 (12.8)</td>
<td>156 (20.0)</td>
<td>199 (25.5)</td>
<td>122 (15.6)</td>
<td>205 (26.2)</td>
<td>782</td>
</tr>
<tr>
<td>Fearful</td>
<td>58 (7.5)</td>
<td>176 (22.6)</td>
<td>234 (30.8)</td>
<td>116 (14.9)</td>
<td>194 (24.9)</td>
<td>778</td>
</tr>
<tr>
<td>Aggressive</td>
<td>31 (4.0)</td>
<td>96 (12.4)</td>
<td>186 (23.9)</td>
<td>182 (23.4)</td>
<td>282 (36.3)</td>
<td>777</td>
</tr>
<tr>
<td>Alternative surfaces</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calm</td>
<td>13 (1.7)</td>
<td>74 (9.5)</td>
<td>223 (28.6)</td>
<td>170 (21.8)</td>
<td>301 (38.5)</td>
<td>781</td>
</tr>
<tr>
<td>Fearful</td>
<td>2 (0.3)</td>
<td>60 (7.7)</td>
<td>202 (26.0)</td>
<td>186 (23.9)</td>
<td>327 (42.1)</td>
<td>777</td>
</tr>
<tr>
<td>Aggressive</td>
<td>1 (0.1)</td>
<td>23 (3.0)</td>
<td>110 (14.1)</td>
<td>196 (25.2)</td>
<td>448 (57.6)</td>
<td>778</td>
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Results describe the reported use of minimal restraint on aggressive cats during handling (examinations: n=222; procedures n=204), and the use of full-body with scruff restraint on fearful (examinations: n=229; procedures: n=207) and aggressive (examinations: n=223; procedures: n=207) cats.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aggressive Minimal</th>
<th>Fearful Full + Scruff</th>
<th>Aggressive Full + Scruff</th>
</tr>
</thead>
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<td>p-value</td>
<td>OR 95% C.I.</td>
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<tr>
<td><strong>Examination</strong></td>
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<td></td>
</tr>
<tr>
<td>AAFP</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes / No</td>
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<td>0.05, 0.63</td>
<td>0.01</td>
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<tr>
<td>Cats handled/ day</td>
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</tr>
<tr>
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<td></td>
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<td>Canada / US</td>
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<td>1.05, 3.07</td>
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<td></td>
</tr>
<tr>
<td><strong>Procedure</strong></td>
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<td></td>
</tr>
<tr>
<td>AAFP</td>
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<td></td>
</tr>
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<td>0.13, 0.55</td>
<td>0.0004</td>
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<td></td>
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<tr>
<td>Canada / US</td>
<td>2.11</td>
<td>1.14, 3.96</td>
<td>0.02</td>
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<tr>
<td>Grad year</td>
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Table 2.6 Demographic factors associated with handling methods used for fearful and aggressive cats by non-veterinarian staff in Canada and the USA. Results describe the use of full-body with scruff restraint on fearful (examinations: n=631; procedures: n=517) cats, minimal restraint on aggressive (examinations: n=608; procedures n=515) cats, and full-body with scruff on aggressive (examinations: n=613; procedures: n=521) cats during handling.

<table>
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<th>Variable</th>
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<th>Aggressive Full + Scruff</th>
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<td>OR 95% C.I.</td>
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<td>p-value</td>
<td>p-value</td>
<td>p-value</td>
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<td>Examination</td>
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<td>0.008</td>
<td>0.005</td>
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<td>2006 – 2015 / ≤ 2005</td>
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<td>AAFP</td>
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<td>0.01</td>
<td>0.51 0.30, 0.90</td>
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<td>&lt;0.0001 0.44 0.26, 0.73</td>
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<td>&lt;0.0001</td>
<td>0.44 0.26, 0.73</td>
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71
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<th>Grad year</th>
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Table 2.7 Demographic factors associated with handling methods used for fearful and aggressive cats by veterinarians and non-veterinarian staff in Canada and the USA. Results describe the use of minimal restraint on aggressive (examinations: n=845; procedures n=732) cats, and use of full-body with scruff restraint on fearful (examinations: n=874; procedures: n=738) and aggressive (examinations: n=851; procedures: n=742) cats.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aggressive Minimal</th>
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<th>Aggressive Full + Scruff</th>
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<td></td>
<td>OR 95% C.I.</td>
<td>p-value</td>
<td>OR 95% C.I.</td>
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<td><strong>Examination</strong></td>
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</tr>
<tr>
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<td>0.013</td>
<td></td>
</tr>
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<td>4-6 / ≥7</td>
<td>0.57 0.40, 0.81</td>
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<td>0-3 / ≥7</td>
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<tr>
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<td>AAFP</td>
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<tr>
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<td>ns</td>
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<td>0.43 0.29, 0.63</td>
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Fig 2.1. Frequency of use for 15 different handling techniques for calm cats during a) examinations, and b) procedures. Study participants included veterinarians and non-veterinarian staff members from Canada and the USA, and responses from both groups are pooled.

a)
Fig. 2.2 Frequency that veterinarians and non-veterinarian staff members use the 15 different handling techniques on fearful cats during a) examinations, and b) procedures.

a)
Fig 2.3 Frequency that veterinarians and non-veterinarian staff members use the 15 different handling techniques on aggressive cats during a) examinations, and b) procedures.

a)

b)
Chapter 3: Testing Two Behavioural Paradigms for Measuring Post-Handling Cat Aversion Behaviour

Abstract

Owned, shelter, and laboratory cats undergo handling and restraint throughout their lifetime for routine health examinations and necessary procedures. Many cats display fear and aggressive behaviour during health examinations, and there is potential for these behaviours to result in incomplete examination, and inadequate diagnosis and treatment, which are cat welfare concerns. Given the lack of validated methods to assess cat responses to restraint, the current study aimed to validate two behavioural paradigms: 1) a Handler Aversion Test, and 2) a Conditioned Place Aversion (CPA) test, to assess aversion response differences between passive restraint (the control) and full-body restraint (known to be negative). Cats were initially assessed as either friendly or unfriendly during interactions with a stranger, and this was included as a covariate in analyses. During the Handler Aversion Test, cats were restrained with the passive (n=20) or full-body (n=18) restraint, and aversion was assessed by measuring cat latency to approach the handler. CPA testing was carried out separately in laboratory (n=10) and shelter (n=42) cats using an apparatus made up of two visually-distinct compartments: cats were handled with passive restraint on one side, and full-body restraint on the other side, with handling methods counter-balanced between compartments. After handling, cats were placed into the apparatus and dwelling time was assessed for each compartment. For the Handler Aversion Test, only 38 out of 51 cats could be trained to walk the required runway, and latency to approach the handler was not significantly different between treatments (P > 0.1). During CPA testing, laboratory cats and friendly shelter cats showed aversion towards the full-body restraint compartment, spending most of their time in the passive compartment (P=0.043, P=0.035, respectively); a result not seen in unfriendly shelter cats. The current results suggest that, as assessed in the current study, the CPA test is more sensitive than the Handler Aversion Test for detecting differences in cat aversion responses between a known negative and control restraint technique.
1. Introduction

Owned, shelter, and laboratory cats all undergo handling and restraint for routine health examinations and necessary procedures. However, little data exist on cat handling and restraint practices. Many cats show fear and aggression during physical examinations (Glardon et al., 2010; Mariti et al., 2016), and anecdotal reports suggest the resulting negative experience may increase the potential for fear and aggression upon subsequent handling (Mariti et al., 2016; Rodan, 2010). Fear and aggressive behaviour can also lead to improper examination and inadequate diagnosis and treatment, which are cat welfare concerns for all owned, laboratory and shelter cats.

In recent years, there has been increased awareness that excessive restraint may have negative health and welfare effects on cats, with increased consideration of low-stress handling techniques (Moffat, 2008; Patronek and Lacroix, 2001). Many low-stress cat handling initiatives exist, such as Sophia Yin’s Low Stress Handling University, the Fear FreeSM Initiative, and Cat Friendly Practices®, which aim to reduce negative responses during handling, and encourage positive experiences for cats. However, current handling recommendations are based on anecdotal best practice rather than scientific evidence. Therefore, it is important to assess whether these recommendations do in fact improve cat welfare. One major barrier to assessing these recommendations is the lack of validated assessment tools for identifying cat responses to handling techniques. The current study aimed to fill this knowledge gap by validating two paradigms that use avoidance behaviour to measure motivation to avoid a negative stimulus. We compared cat aversion behaviour between passive restraint (the control) and full-body restraint. Full-body restraint is known to be negative: it immobilizes, which elicits fear (Grandin, 1997), and is commonly used as a psychological stressor to model stress in various species (Buynitsky and Mostofsky, 2009).

In previous research handler aversion tests have been used to evaluate the motivation of an animal to approach or avoid a handler based on previous handling experience with that particular handler. This type of testing has involved assessment of a variety of aversion responses: avoidance distance of an
approaching handler (dairy heifers: Breuer et al., 2003; Lurzel et al., 2016), latency to enter and move down a run (Pajor et al., 2000; Rushen, 1986a,b), force required to move the animal down the race post-treatment (Pajor et al., 2000), distance from a handler post-handling (dairy cows: Munksgaard et al., 1997), time to approach within a particular distance from a familiar handler (dairy heifers: Breuer et al., 2003), and approach and avoidance behaviour towards an unfamiliar person (dairy goats: Mersmann et al., 2016). In addition, an increase in aversion behaviours have been observed in dairy cattle, sheep, goats, and mice, in response to rough handling compared to gentle handling (Gouveia and Hurst, 2003; Lurzel et al., 2016; Mersmann et al., 2016; Munksgaard et al., 1997; Pajor et al., 2003; Rushen, 1986a), and aversion towards an area where full-body restraint occurred has also been examined (sheep; Grandin et al., 1986; Rushen, 1986a). To our knowledge, this type of handler aversion testing has not previously been examined in cats, but previous studies suggest that cats can learn these types of tasks. A study by Roberts (1958) suggests cats can be trained to walk a straight alleyway, with cats learning to run to the end of the alleyway to turn off electrical brain stimulation (thalamus, hypothalamus, midbrain). Cats have also been trained to walk maze structures (Mayes et al., 2015; Norrsell, 1974; Sherman et al., 2013), to complete elevated plank-walking tests (Lindstrom and Norrsell, 1971; Stiegerwald et al., 1999), to avoid areas within a T-maze where foot-shock had occurred (Roberts, 1958). Therefore, we devised a long walkway apparatus to assess post-restraint avoidance behaviour towards a handler. Cats were handled with either a 1) passive restraint (control), or 2) full-body (known negative; table 1) restraint technique, then underwent testing for handler aversion. We hypothesized that after full-body restraint the handler would be perceived as a potential threat by the cat. We predicted that cats handled with full-body restraint would have increased latencies to approach the handler, in comparison to cats handled with the passive restraint method.

The Conditioned Place Aversion (CPA) test is another potential approach to assess animal aversion. This classical conditioning paradigm was developed from the conditioned place preference (CPP) test. The CPP test focuses on incentive motivations for rewards, while the CPA test focuses on
responses towards aversive stimuli such as a shock (Tschentke, 2007). Past studies have used two-compartment CPA testing to examine avoidance learning in cats, using a foot shock as a painful stimulus that elicits avoidance behaviour towards the compartment where the shock occurred (Lubar 1964; McAdam, 1964; McCleary, 1961; Robert, 1958; Sarkisov et al., 2002). However, to our knowledge, restraint has not been used as a stimulus to condition avoidance using this paradigm. Thus, the current study also assessed the validity of the CPA test for assessing aversion to handling in cats by comparing full-body versus passive restraint. We predicted that after handling, cats would choose to spend the majority of their time in the compartment where passive restraint occurred, and less time in the compartment where full-body restraint occurred.

Considering that cat responses to handling by a stranger may be influenced by various factors such as socialization and early handling experiences (Collard, 1967; Karsh, 1984; Wilson et al., 1965), in addition to genetics (Grandin and Shively, 2015; Reisner et al., 1994), cats were categorized as friendly or unfriendly based on an Unfamiliar Person Test (adapted from McCune, 1995). Handlers are often unfamiliar to cats, therefore this test assessed a cat’s willingness to initiate proximity with a stranger, as well as responses to interactions with a stranger. We hypothesized that unfriendly cats would display more avoidance behaviours than friendly cats, during interactions with an unfamiliar person, and that this response would influence responses during handler aversion testing and CPA testing.

The test assessing handler aversion was conducted in shelter cats, and the CPA test was conducted separately in both laboratory and shelter cats. The current study aimed to examine the efficacy of both handler aversion testing and CPA testing, for use in assessing cat avoidance to a known negative restraint technique (full-body) in comparison to passive (control) restraint. During this work, we also assessed whether responses to a stranger affected cat responses to handling.
2. Materials and Methods

All animal procedures were approved by the University of Guelph’s Animal Care Committee, and all cats were deemed healthy by a licensed veterinarian. If a cat showed aggressive behavior during an experimental procedure (e.g., attempts to bite or scratch), testing stopped and the cat was taken out of the study for the safety of the cat and the researchers. All cats were blocked for sex and age, then randomly allocated to treatment group.

2.1 Method 1 - The Handler Aversion Test

2.1.1 Animals

This study used 51 (30 male, 21 female) non-pedigree shelter cats from a shelter located in Ontario Canada. Cat age ranged between 1 - 10 years old, with an average age of 4.8 (SD ± 2.8) years old. At the time of testing cats had been housed in the shelter for a minimum of 7 d, and were available for adoption. Of the cats used, six (2 females, 4 males) had tested positive for feline immunodeficiency virus, but showed no clinical signs and thus were deemed healthy by the licensed veterinarian. Shelter cats were housed in various rooms within the shelter, separate from the test room. All cats were singly housed, except two sibling pairs that were pair-housed together.

2.1.2 Experimental Procedure

The experiment consisted of two consecutive procedures: 1) an Unfamiliar Person Test, and 2) a Handler Aversion Test. The latter consisted of a training phase, a handling phase, and a testing phase. All procedures took place in a test room within the shelter, away from the cat holding rooms. Testing took place between 9:00 – 17:00 h, for five consecutive days.

2.1.2.1 Unfamiliar Person Test

All animals underwent an Unfamiliar Person Test adapted from McCune (1995). This test assessed cat willingness to approach a stranger, and cat responses to an approaching stranger.

Experimental set up (Fig. 2) and testing procedure were identical to those outlined in section 2.2.1 of
Moody et al. (2018). In brief, this test consisted of two phases: 1) willingness of the cat to approach a stranger sitting in a chair, and 2) whether the cat allowed the stranger to approach and stroke the cat.

2.1.2.2 Handler Aversion Test - Apparatus and Training Phase

The Handler Aversion Test apparatus consisted of a white Plexiglas walkway (175 cm x 30 cm x 75 cm), which was long enough to allow cats to clearly express aversion responses (Fig. 3). Tape was used to mark 25 cm increments down the length of the walkway floor to allow visual measurement of how far each cat travelled. The apparatus was placed on a table (182 cm long x 75 cm wide x 72 cm high) with a second table placed perpendicular to the first table and extending 75 cm in front of the end of the walkway. The handler stood behind Table 2, facing the end of the walkway. During training, treats were placed down the walkway and on table 2 at a location 40 cm in front of the walkway, and 30 cm from the handler. The apparatus was cleaned with all-purpose cleaner between cats.

Cats were trained to walk the length of the walkway and exit the end with all four paws. They completed a maximum of three training runs consisting of three trials each. For each trial, the handler (white coat) stood at the end of the walkway, while the assistant (blue coat) placed the cat at the start of the walkway and took a step back. For the first trial, three treats (Seafood Medley Flavour, Temptations®, Whiskas, Mars Canada Inc., Bolton Ontario, Canada) were placed down the walkway, in addition to one treat placed on the table, and the cat had 2-min to exit the walkway. For the second trial, treats were placed at the end of the walkway apparatus and on the table, and the cat had 1 min to exit the walkway. For the third trial, one treat was placed on the table, and the cat had 1 min to exit the walkway. If the cat failed to exit the walkway in any of the three trials, it started a new training run back at trial one, and was given a total of three attempts to complete the three trials consecutively. Once the cat had successfully completed all three consecutive trials, the cat was deemed ‘trained’ and moved onto the handling phase of the study. If the cat could not complete the trials in three attempts, it was deemed ‘untrained’ and removed from the study.

2.1.2.2.1. Handler Aversion Test - Handling Phase
The mock examination set up and testing procedure was identical to that outlined in section 2.2.2. of Moody et al. (2018). In brief, each cat was restrained for 2 min with either passive restraint or full-body restraint (Figure 1). During restraint, mock examinations consisted of taking the cat’s respiratory rate, heart rate, ear temperature, and pupil dilation pictures. After the 2-min restraint period was up, cats were released.

2.1.2.2.2 Handler Aversion Test - Testing Phase

Immediately following release from restraint, the assistant picked up and placed the cat at the entrance of the walkway apparatus. The handler stood at the end of the walkway apparatus, and testing ended when the cat exited the walkway with all four paws, or after 1 minute. No treats were used during testing so that cat movement towards or away from the handler was motivated by the handling experience and not the treat.

2.2 CPA Testing: Laboratory Cats (n=10)

2.2.1 Animals

The subjects were seven female and three male purpose-bred, domestic short-haired cats maintained in a laboratory animal facility (CanCog Technologies, Fergus, ON Canada). Cats were group-housed in colony rooms, separate from the test rooms, and were aged between 4 -13 years old, with an average (± S.D.) of 9 (± 3.3) years old.

2.2.2 Experimental Procedures

The experiment consisted of two procedures: 1) the Unfamiliar Person Test, and 2) CPA testing. CPA Testing involved three phases that took place in the apparatus: 1) habituation, 2) handling, and 3) preference testing (dwelling time). Testing was completed in separate test rooms, within the same laboratory animal facility where the cats were housed. The study was conducted over 3 d between 7:30 – 16:30 h. All cats underwent the Unfamiliar Person Test on day one, and CPA testing on either day two or three.
2.2.2.1 Unfamiliar Person Test

The experimental set up and procedures were identical to that laid out in section 2.1.2.1 except that the test area had a perimeter of 11.3 m in a windowless room, and researchers wore light blue facility-dedicated scrubs.

2.2.2.2 CPA Test

The CPA apparatus (1.8 m length x 0.76 m width x 0.78 cm height; Fig. 3.4a) consisted of two adjoining compartments, each 74 cm length x 74 cm width x 78 cm height, constructed out of epoxy-coated steel shelving pieces (39 cm x 37 cm, For Living™ Canadian Tire). The ends of each compartment were covered with a sheet of white corrugated plastic board (Plaskolite, 0.4 cm thick, Model#1TW4896A, Ohio, USA). In addition, white corrugated plastic was attached to the top and the back of each compartment. The front of each compartment was left uncovered to allow video recording of the procedures. One compartment was left white, while the other side had 3 mm thick black plastic (Frank, Canadian Tire, Ontario Canada) covering the white board, creating two visually distinct compartments, one white and one black. A divider between the compartments was constructed using shelving pieces and plastic board, with corresponding compartment colours, and half of this divider was removable.

The apparatus was placed on a metal table (180 cm x 76.2 cm x 91.5 cm), with four rubber mats (43 cm x 91.4 cm, Model 090500, Rubbermaid®, Newell Rubbermaid, Oakville, Ontario, Canada) placed underneath the apparatus to minimize slipping; two blue mats on the black side, and two white mats on the white side. Three research personnel were present during testing: a handler, a research assistant, and a facility technician. The apparatus was cleaned between cats using all-purpose cleaner.

CPA testing involved three phases that took place in the apparatus: 1) habituation, 2) handling, and 3) preference testing (dwelling time)

2.2.2.2.1 CPA Test - Habituation

During habituation, the detachable portion of the divider was removed so that cats could freely roam between the two compartments. Each cat was placed into the apparatus through one of the two
compartment ends, counter-balanced across cats. Three treats were placed into each side of the apparatus to encourage the cat to explore. The facility technician retrieved a cat from its home room, placed the cat into the apparatus, and closed the end to ensure the cat could not escape. All three research personnel moved to an area within the test room that was out of view, and stayed silent. The session lasted 2 min, after which the research assistant removed the cat from the apparatus and placed the cat into a stainless-steel holding cage (76.2 cm x 46.3 cm) within the room. The ends of the apparatus were opened, and the compartment divider placed inside. Any remaining treats inside the apparatus were removed. After 1 min, the handling phase commenced.

2.2.2.2 CPA Test - Handling

Cats were restrained twice with each restraint method, and each restraint method was applied in only one of the distinct compartments. Application of the restraint methods alternated between sides with restraint method and compartment was counter-balanced between cats.

First, the research assistant removed the cat from the holding cage and placed her into the apparatus, then the handler placed the cat into either passive or full-body restraint. If the handler had trouble getting the cat into restraint, the research assistant helped. Cats were restrained for 1 min. After restraint, the research assistant picked up the cat and carried her to the other compartment for the next restraint method. This procedure repeated until the cat had been restrained with each handling technique twice. Cats were not restrained more than two times with each restraint technique to avoid over-arousal and ceiling effects, but were restrained more than once with each technique to allow the cat to learn the association between each handling method and compartment. After the handling procedures were completed, the research assistant placed the cat back into the holding cage for 1 min.

2.2.2.3 CPA Test - Testing

For the testing phase, the detachable portion of the divider was removed so that the cat could move freely to whichever compartment it preferred. The research assistant removed the cat from the
holding cage and placed the cat into the apparatus. The apparatus was closed to ensure the cat could not escape and the research personnel moved out of view. This testing phase lasted for 2 min.

2.3 CPA Test: Shelter Cats (n=45)

2.3.1 Animals

Cats (18 male, 27 female) were from five different animal shelter facilities across the Greater Toronto Area in Ontario, Canada. The distribution of cats from each shelter facility was as follows: facility one (3 females, 4 males), facility two (5 females), facility three (8 females, 7 males), facility four (1 female, 2 males), and facility five (7 females, 5 males). Cats were aged between 1 – 10 years old with an average (± S.D.) of 4 (± 2.5) years old, and had been housed in the facility for a minimum of 5 days. All cats were singly housed, except for one sibling pair housed together. Of the cats used, one female had tested positive for feline immunodeficiency virus, but showed no clinical signs and thus was deemed healthy by a licensed veterinarian.

2.3.2 Experimental Procedures

The experiment consisted of two procedures: 1) the Unfamiliar Person Test, and 2) the CPA test, which occurred in test room separate from the cat’s housing rooms. Testing took place over 19 d between 10:00 – 17:00 h. All cats underwent the Unfamiliar Person Test then the CPA test, consecutively.

2.3.2.1 Unfamiliar Person Test

The experimental set up and procedures were identical to that as outlined in section 2.1.2.1, except the perimeter of the test areas ranged between 9.5 m – 12.1 m.

2.3.2.2 CPA Test

The experimental set up was identical to that outlined in section 2.2.2.2, except that the CPA apparatus (Fig. 3.4b) was placed on a plastic foldable table (1.83 m length x 0.76 m width x 0.84 m height; Lifetime®, Clearfield Utah, USA), and the apparatus was modified slightly with blue and green patterned polyethylene vinyl acetate (Mainstays Shower Curtain, Walmart, China) replacing the black plastic sides to ensure equal light levels throughout the apparatus. Although there is no scientific
consensus on whether cat vision is dichromatic or trichromatic (Kelber et al., 2003), the blue-green spectrum is within their visual range, and behavioural discrimination of these colors has been demonstrated (Mello and Peterson, 1964). All windows present in the test room were covered with blackout curtains (Model 49595, Mainstays Blackout Energy Efficient Grommet Curtain Panels, China) to ensure light levels remained consistent throughout testing, and to eliminate distractions from outside the room.

Habituation, handling and testing phases were identical to the procedures outlined in section 2.2.2, except that the holding cage in three of five shelters was a soft-sided crate (60.96 cm length x 45.72 cm width x 43.18 cm height; Precision Pet Products Great Crate 2000, California, USA).

2.4 Data Collection

All experimental procedures were video recorded using high definition cameras (Models HDR-CX220 and HDR-CX330, Sony Electronics, Corporation, China) in high definition recording mode, for later behavioural scoring. Where possible, observers were blind to treatment during behavioural scoring. In some videos the handling method was obvious and could not be obscured, but in these cases observers were naïve to the studies and did not know the hypotheses.

During the Unfamiliar Person Test, cats were scored and categorized as either friendly or unfriendly. Friendly cats had to satisfy the following three conditions: 1) completely exit carrier, 2) pass the 50-cm semi-circle surrounding chair, and 3) allow the unfamiliar person to approach and stroke the cat three consecutive times. Cats that did not satisfy one or more of these conditions were categorized as unfriendly.

Of the fifty-one cats included in the Handler Aversion Test, four (3 males, 1 female) did not complete testing due to aggression (attempts to bite and/or scratch), and nine (2 male, 7 female) could not be trained, leaving 38 cats in this dataset. Training videos were scored for latency to approach the handler, defined as the time the cat’s four paws are placed onto the walkway, until the cat fully exits the walkway with all four paws. To determine latency to exit the walkway in relation to each cat’s walking pace,
latency to approach the handler during the test run was subtracted from latency to approach the handler during the cat’s third training run. The amount of time the cat remained immobile in the walkway was recorded during the test run by dividing the duration of time spent immobile, over the latency to exit the walkway.

Of the CPA shelter cats, one female escaped from the CPA apparatus, and two additional females displayed aggressive behaviour, thus these cats did not complete testing. Forty-two shelter cats were included in the final analyses. CPA testing videos for both laboratory and shelter cats were scored for the total time spent in each compartment (defined as both front paws and the head in the compartment) out of the 2-min test period.

After initial analyses, CPA shelter cat test videos were also scored for the total time cats spent immobile (defined as motionless tail, body, and limbs) in either compartment. This was examined to test the post-hoc hypothesis that unfriendly cats spent more time immobile than friendly cats.

2.5 Statistical Analysis

All analyses were conducted using SAS v. 9.3. or SAS University Edition 2016 (SAS Institute, Cary NC, USA), with P values < 0.05 considered statistically significant. Continuous response variables in which the cat was only assessed for a limited time period, were examined as censored data, and measured as the logit transformation of time (Cox and Snell, 1989). Models were built using a backward elimination process whereby explanatory and response variables were removed one at a time if P > 0.05. Interaction variables based on all variables in the models were tested for inclusion. Model fit was examined using residual plots, histogram plots, Shapiro-Wilk normality test (alpha 0.05, P value < 0.05), the coefficient of determination (R-squared), and AIC (with a lower value preferred). When the normality assumption was not met, a logit transformation was used to meet it.

2.5.1 Handler Aversion Testing in Passive (n=20) Versus Full-body (n=18) Restrained Cats

Three linear regression models were built with covariates (sex, age, friendliness) and restraint type to determine associations between treatment and: 1) latency to approach the handler, 2) latency to
exit the walkway in relation to the last training run, measured as the logit transformation of time, and 3) the time spent immobile in the walkway out of the total time spent in the walkway.

2.5.2 CPA Testing: Laboratory (n=10) and Shelter (n=42) Cats

Time spent in the full-body restrained compartment was subtracted from time spent in the passive compartment to calculate the difference between the two sides. For laboratory cats, the data set did not meet the normality assumptions stated above, therefore the difference between the two sides was assessed using a Wilcoxon signed-rank test. Analyses could not be performed separately for friendly and unfriendly cats due to a small sample size.

For shelter cats, a mixed linear regression model was used to examine the difference in the amount of time cats spent between the passive and full-body compartments, measured as the logit transformation of time. Models were built with explanatory variables (sex, age) and id as a random effect. In addition, a mixed linear regression model was built with covariates (sex, age) and friendliness, with shelter as a random effect, to assess the association between friendliness and time spent immobile during testing. The normality assumption was not met, and transformations (log, square root) did not improve fit.

3. Results

3.1 Handler Aversion Testing

In total, 38 out of 51 cats (20 passive [10 friendly- 4 F, 6 M; 10 unfriendly- 4 F, 6 M], 18 full-body [13 friendly- 4 F, 9 M; 5 unfriendly- 1 F, 4 M]), were successfully trained to walk the walkway. Latency to approach the handler was not significantly different between treatments ($F_{1,35} = 0.42; P = 0.52$; mean s [95% CI]: passive 30.3 s [14.5, 45.9] vs full-body 22.3 s [8.4, 40.8]). The proportion of time cats spent immobile in the walkway during the test run was not significantly different between treatments ($F_{1,34} = 0.30; P = 0.59$; mean s [95% CI] passive 0.55 s [0.41, 0.70] vs full-body 0.50 s [0.33, 0.66]). There was an interaction between treatment and sex when assessing the difference between test and
training runs ($F_{3,32}=2.56$, $P = 0.019$), with passively held males taking on average 3.2 (95% CI: 1.3, 7.9; $P = 0.016$) times longer to leave the walkway than passively restrained females.

3.2 CPA Testing: Laboratory and Shelter Cats

Figure 5 shows the mean (95% CI) time that laboratory, friendly shelter, unfriendly shelter, and all shelter cats, spent in the passive and full-body compartments. Of the 10 laboratory cats, eight (6 female, 2 male) were categorized as unfriendly and two (1 female, 1 male) as friendly. Laboratory cats spent more time in the passive compartment than the full-body compartment (mean difference [95% CI]: 72.2 s [10.5, 133.9]; $P=0.04$).

Of the 42 shelter cats, 26 (14 female, 12 male) were categorized as friendly and 16 (10 female, 6 male) as unfriendly. Overall, shelter cats did not spend more time in the passive compartment than in the full-body compartment ($P= 0.066$). However, the mean difference varied when cats were split by friendliness; friendly cats spent more than half their time in the passive compartment (mean proportion [95% CI]: 84.4 % [56.6, 95.7]; $P=0.02$), while unfriendly cats did not (mean proportion [95% CI]: 38.5 % [9.3, 79.4]; $P=0.61$). Immobility was assessed in shelter cats to determine whether it differed between friendly and unfriendly cats, but no difference was detected (mean difference [95% CI]: 15.8 s [ -7.2, 38.7], $P= 0.17$; $F_{1,36} = 1.94$, $P=0.17$).

4. Discussion

The Handler Aversion and CPA tests were used to examine cat avoidance behaviour in response to handling and restraint. Both paradigms required avoidance learning: the Handler Aversion Test required a learned association between the handler and a single restraint technique, while the CPA test required differentiation between two compartments by each cat, and learned associations between each compartment and a particular restraint technique. The CPA test results showed that friendly shelter cats chose to spend more time in the passive compartment in comparison to the compartment where full-body restraint occurred. This suggests that these cats distinguished between the two compartments, choosing to
avoid the compartment where the negative condition occurred. However, a treatment effect was not seen in unfriendly shelter cats, or in the overall shelter cat data set. Consistent with the results obtained for friendly shelter cats, during CPA testing laboratory cats spent more time in the compartment where passive restraint occurred, and this effect was not dependent on being categorized as friendly or unfriendly. While the CPA test successfully differentiated between handling treatments in the current study, its utility for use in further studies is somewhat limited. The test may not be sensitive enough given the large sample size required for comparing friendly shelter cat aversion responses to handling techniques, which may not be practical for routine studies. The sample size required to detect treatment differences was reduced when using laboratory cats, thus this test may be more useful and practical for use with laboratory cat populations.

The CPA paradigm has been successfully used to examine avoidance behaviour in laboratory cats, with past studies inducing conditioned-avoidance of one compartment with the use of a foot shock stimulus, and the second compartment used as a safe area (Delgado et al., 1954; Lubar, 1964; McAdam, 1964; McCleary, 1961; Roberts, 1958; Sarkisov et al., 2002; Thomas and DeWald, 1977). In comparison, we used full-body restraint as an aversive stimulus in one compartment, and applied a second handling treatment (passive restraint) in the other compartment. Full-body restraint is a psychological stressor which does not elicit pain, and thus may be less aversive than the shock stimulus used in past research. As well, the second compartment was associated with passive restraint; some cats might have been averse to this restraint, so it is not a safe compartment, per se. Thus, animals that perceived passive restraint as negative would have been expected to differentiate between the two negative options rather than simply escaping a single negative.

Another methodological difference between the current study and previous cat CPA research is the features used to differentiate the two compartments. The apparatus in the current study consisted of two-compartments with color differences to create two visually distinct compartments, while only one past study described color differences (black versus white) between compartments (Delgado et al., 1954).
Others have used a light source (Davis and Thompson, 1968), or small and large compartments (Lubar, 1964; McCleary, 1961) as distinguishing compartmental features. In the current study, the apparatus used for shelter cats had different coloured compartments than the laboratory cat apparatus, which may have contributed to the differing results seen between the two cat populations. Research indicates that cats are capable of discriminating blue from different shades of grey (Clayton and Kamback, 1966), and from other colors (Mellow and Peterson, 1964; Sechzer and Brown, 1964), suggesting the two compartments should have been distinct for both apparatuses.

Past CPA studies did not categorize cats as friendly or unfriendly since responses to handlers were not relevant to the study objectives or designs based on the stimuli used (foot shock) (Delgado et al., 1954; Lubar, 1964; McAdam, 1964; McCleary, 1961; Roberts, 1958; Sarkisov et al., 2002; Thomas and DeWald, 1977). However, the current study examined cat responses to handling by an unfamiliar person, thus it was important to consider baseline temperament responses to interactions with an unfamiliar person. Given that a treatment effect was only seen in friendly shelter cats, we considered three plausible explanations for the differences detected. First, since unfriendly cats did not approach or let the unfamiliar person approach and pet them, it is possible that this group of cats perceived all handling as aversive, and did not differentiate between the two handling methods. A second possible hypothesis is that unfriendly cats spent more time immobile, preventing movement during testing and skewing the results. Immobility is a common unconditioned fear response, and is widely used to assess conditioned fear in various learning paradigms (Hagenaars et al. 2014). Previous research suggests that shy and anxious cats show more defensive behaviours and immobility in response to a threatening stimulus (Adamec and Stark-Adamec, 1989). Given that unfriendly cats are more likely to be fearful in contexts involving humans, we completed a post-hoc assessment to determine whether these cats showed more immobility during CPA testing. In contrast to our predictions, there was no difference in time spent immobile between friendly and unfriendly shelter cats. A third explanation is that unfriendly shelter cats had higher negative baseline responses or were more negatively affected by the testing procedures, resulting in an inability to learn the
association between the compartments and the handling treatments. General learning impairment in humans and other animal species is a well-known phenomenon when placed under high levels of stress (Mendl, 1999; Shors, 2004), and a shelter environment may be stressful for cats due to confinement, the presence of loud noises, and forced exposure to unknown people, cats, and other animal species. Further research is needed to explore the potential effects that stress may have on learning when using the CPA paradigm in cats.

The difference in sample size required to perform the CPA test in laboratory versus friendly shelter cats, suggests that differences exist between these populations. Past literature involving CPA tests in cats (Delgado et al., 1954; Lubar, 1964; McAdam, 1964; McCleary, 1961; Roberts, 1958; Sarkisov et al., 2002; Thomas and DeWald, 1977) have not specified the source of cats used, and thus no differences between sources have been identified until now. Laboratory cats used in the current study were purpose-bred, socialized, routinely handled and restrained for research purposes, and housed long term in colony rooms with conspecifics. In contrast, shelter cats had unknown socialization and handling histories, were single-housed in cages, and differed in length of stay at the shelter facilities. It is likely the shelter cats were more stressed in the shelter living environment, than the laboratory cats. Shelter cats are exposed to unpredictable loud noises, forced exposure to unknown people, cats, and other animal species, and may not have been habituated to this environment. Thus, responses of the shelter cat population are likely to be more variable than those of laboratory cats.

The Handler Aversion Test, as used in the current study, was not suitable for detecting treatment differences in cat aversion responses towards the handler. In addition, nine cats could not be trained to walk the walkway, which restricts that utility of this paradigm. The methodology used in the current test was similar to that applied by Pajor et al. (2000) in dairy cattle, which used a race with high sides to assess reluctance to approach the handler; however, the authors applied treatments (duration 1 - 3 min) three times a day for up to four consecutive days, while the current study applied a single handling treatment once per cat. Other handler aversion studies have used a Y-maze (Pajor et al., 2003; Rushen,
1986a) or alternative set up, that did not include a race or maze apparatus (Breuer et al., 2003; Grandin et al., 1986; Lurzel et al., 2016; Mersmann et al., 2016; Munksgaard et al., 1997; Rushen, 1986b). Differences in methodology between the current and past handling aversion tests might explain why the full-body restrained cats did not show increased handler aversion in comparison to passively restrained cats. It is possible that handling by both researchers were negatively perceived. The research assistant standing at the start of the walkway had retrieved the cat from the home cage, carried the cat to the friendliness test area, then to the walkway apparatus, and placed the cat into the walkway during training and testing. As well, the research assistant was involved in the mock examination, which was performed before walkway testing, recording various physiological and behavioural parameters, some of which involved handling the cat. The cat may have stayed in the walkway to avoid the researchers at the entrance (research assistant) and exit (handler), creating a bias towards the null hypothesis, making it less likely to see a difference in latency to approach between the two treatment groups.

The current Handler Aversion Test used a between-subject design, restraining cats with only one handling treatment to avoid the potential effect of over-handling. While this design increases variability across treatments, it was thought that multiple restraint experiences for cats would lead to a cumulative effect being assessed, and thus this design was avoided. However, this was not a concern with the CPA within-subject design, because each restraint was associated with a particular compartment and not the handler. Past aversion studies have successfully used both within subject designs (Grandin, 1986; Munksgaard et al., 1997; Pajor et al. 2003; Rushen, 1986a), and between subject designs (Breuer et al., 2003; Pajor et al., 2000; Rushen, 1986b), but power would have been increased using a within subject design. Perhaps refinements made to the Handler Aversion Test, such as using two handlers, handling each cat with a different handling technique, (within-subject design), and adding multiple restraint sessions, would yield a more successful outcome. However, the training issue remains a concern regardless of these refinements, and restricts the utility of this approach.
5. Conclusion

The current results suggest that based on the methodologies tested here, the CPA test is more sensitive than the Handler Aversion Test in detecting differences in cat aversion behaviour between a known negative and control restraint technique. Practical use of the CPA paradigm with shelter cats may be limited by the large sample size required, in addition to issues with unfriendly cats. Nonetheless, the results provide the first scientific validation of the CPA paradigm for use in examining post-handling aversion behaviour in cats. Laboratory cats as well as friendly shelter cats showed aversions towards an environment where they had been full-body restrained, choosing to spend more time in an environment where they had been passively restrained.
References


Grandin, T., Shivley, C., 2015. How farm animals react and perceive stressful situations such as handling, restraint, and transport. Animals. 5, 1233-1251.


Figure 3.1 Methods used for handling cats.

a) Passive (control) restraint involved handling the cat lightly, with the least amount of restraint possible, in a position of the cats choosing (standing, sitting or lying), allowing movement of its head, body and limbs, but restricted from moving beyond the area directly in front of the handler.

![Passive (control) restraint](image1.png)

b) Full-body (negative treatment) restraint involved holding the cat laterally, while grasping the front and back legs with a forearm across the neck, and the cat’s back against the handler. The cat was allowed little to no movement of its head, body or limbs.

![Full-body restraint](image2.png)
Figure 3.2 Diagram of the Unfamiliar Person Test area.

![Diagram of the Unfamiliar Person Test area.](image-url)
Figure 3.3 The walkway apparatus for the Handler Aversion Test (N=38).
Figure 3.4 Conditioned Place Aversion (CPA) apparatus for use in examining laboratory (N=10) and shelter (N=42) cat responses to handling with passive and full-body restraint techniques.

a) Laboratory cat CPA apparatus consisting of one white compartment and one black compartment.

b) Shelter cat CPA apparatus consisting of one white compartment and one patterned compartment.
Figure 3.5 Mean (95% CI) time laboratory (N=10) and shelter (N=42) cats chose to spend in the compartment where they were passively versus full-body restrained.

* denotes significance with P < 0.05.
Chapter 4: Can you handle it? Validating Negative Responses to Restraint in Cats


Abstract
Cats routinely undergo handling and restraint for examinations and procedures throughout their lifetime. In recent years there has been increased awareness that some forms of restraint have the potential to negatively impact cat health and welfare, but there has been limited research to assess alternatives. Full-body restraint is known to be aversive and cause stress responses across a range of species. The current study therefore validated measures for identifying negative cat responses to handling by comparing passive restraint (n=22; the control treatment) to full-body restraint (n=25; negative treatment), during a physical examination. Given that cats respond differently to unfamiliar people, and handlers are often unfamiliar to cats, an Unfamiliar Person Test was used to account for differences in cat responses to an unknown handler. Cats were then restrained according to treatment, and assessed for behavioural and physiological responses during the following phases: 1) placement into restraint, 2) restraint, and 3) post-restraint. The results show the odds of struggling were 8.2 (95% CI: 1.47, 58.53; P = 0.009) times greater in cats being placed into full-body restraint in comparison to passively restrained cats. During the physical examination, full-body restrained cats showed more breaths per minute (P = 0.004), more lip licks per minute (F\textsubscript{1,42} = 6.18; P = 0.017), and were more likely to hold their ears in a back or side position during the first 15 seconds of handling (P < 0.0001), compared to passively restrained cats. Analysis of pupil dilation ratio (pupil diameter / iris diameter) showed an interaction between treatment and friendliness (F\textsubscript{1,43} = 8.39; P = 0.006); unfriendly cats handled using full-body restraint showed a larger pupil dilation ratio than unfriendly cats handled with passive restraint (P = 0.0007). Immediately after the handler
released the cat from restraint, the odds of staying on the examination table were 6.1 (95% CI: 1.04, 36.10; F_{1,44} = 4.23; P = 0.0458) times greater for cats restrained with passive restraint, in comparison to cats that underwent full-body restraint. These results provide scientific validation of negative cat responses to handling, and may be used in further research to assess the welfare effects of different handling techniques.
1. Introduction

Recent estimates suggest there are more than 100 million owned cats in Canada and the United States (American Pet Products Association, 2017; Canadian Animal Health Institute, 2017), with more cats present in shelters and laboratories (for which accurate animal numbers are not available). Owned cats are routinely handled at veterinary clinics for health checkups, as well as examinations and procedures for illness or injury. In addition, cats who arrive at an animal shelter must undergo handling and restraint for intake health examinations, as well as any necessary procedures, and laboratory cats used for research purposes undergo yearly health examinations, and are handled and restrained for research procedures.

Historically, restraint has been used to partially or completely immobilize animals during examinations and procedures to prevent human injury (Rodan, 2010). Recent evidence also suggests cats often show fear and aggression during handling which may lead to incomplete examinations, with the potential for inadequate or inaccurate diagnosis and treatment (Glardon et al., 2010; Mariti et al., 2016; Rodan, 2010). In addition, cat owners are sensitive to the way their cats are handled in clinic, and report that clinic visits are stressful for both themselves and their cats (Volk et al., 2014; Volk et al., 2011a; Volk et al., 2011b). The potential stress caused by handling is not only a concern for cats handled and restrained in veterinary clinics, but also for cats in shelter and laboratory facilities. Some have suggested that unnecessary force may be used if a facility lacks a handling expert, and if handling staff are poorly trained, have weak oversight, and/or lack accountability within the facility environment (Patronek and Lacroix, 2001). In recent years, there has therefore been ongoing discussion about the potential for negative health and welfare effects with restraint techniques eliciting fear and stress in cats (Patronek and Lacroix, 2001; Rodan, 2010), with increased consideration of alternative, low-stress restraint and handling techniques (Moffat, 2008; Patronek and Lacroix, 2001; Rodan, 2010).

In a recent survey of veterinarians and animal welfare experts, all agreed that species-specific handling techniques and the ability to recognize, evaluate, and interpret species-specific behaviours were
important factors for ensuring good animal welfare in veterinary clinics (Dawson et al., 2016). Various veterinary organizations such as the American Association of Feline Practitioners and the Catalyst Council, have been recommending changes in the way that cats are handled with the aim of reducing negative responses, and encouraging positive experiences for cats (Rodan, 2010). Although many feline handling guidelines and certification programs exist, for example the AAFP/ISFM Feline-Friendly Handling Guidelines, Fear Free Certification, and Dr. Sophia Yin’s Low Stress Handling Programs, these are all based on anecdotal best practice rather than scientific evidence. Thus, it is important to assess whether these recommended handling techniques do in fact improve cat welfare. One large barrier to accomplishing this is the absence of validated assessment tools for identifying feline responses to restraint. Few studies have assessed feline responses during handling, and none of these studies have validated the response parameters that have been used.

Cat responses to interactions with humans can be influenced by a variety of factors, such as early handling and socialization, which is thought to decrease fear towards unknown humans (Collard, 1967; Karsh, 1984; Wilson et al., 1965) and increase a kitten’s willingness to initiate proximity with people (Karsh, 1984; Karsh, 1983). Genetics and past experiences also alter how an animal perceives and responds to handling (Grandin and Shively, 2015; Reisner et al., 1994), and regular handling is thought to decrease a cat’s fearfulness of humans (Casey and Bradshaw, 2008; Wilson et al., 1965).

Given that cats respond differently to unfamiliar people (McCune, 1995), and handlers are often unfamiliar to cats, an Unfamiliar Person Test (adapted from McCune, 1995) was used to categorize cats as friendly or unfriendly based on their interactions with an unfamiliar person. We hypothesized that unfriendly cats would show more negative responses to handling and restraint by an unfamiliar person in comparison to friendly cats.

The objective of the current study was to validate behavioural and physiological measures for assessing negative responses to handling in cats. Cats were restrained with either a passive technique (control treatment), or full-body restraint (negative treatment) and responses to physical examinations
were assessed. Immobilization resulting from full-body restraint is a psychological stressor that elicits fear (Grandin, 1997), is commonly used to model stress in various species (Buynitsky and Mostofsky, 2009), and has been used to elicit a stress response in cats (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993), demonstrating sympathoadrenal activation measured by increased tonic heart rate and plasma norepinephrine levels (Abercrombie and Jacobs, 1987). Thus, the a priori assumption that full-body restraint was more negative than passive restraint, was made. We assessed a series of behavioural and physiological measures that are indicative of aversion, or that have been previously associated with stimuli thought to elicit negative affect (either widely in other species, or specifically in cats). Actual or attempted avoidance behaviours (struggling, jumping off the examination table, leaving with a short latency) have been widely used to assess aversive experiences and are known to be associated with fear and acute stress in animals (Adolphs, 2013; Archer, 1979). Increased vocalizations (Kaada et al., 1953; Delgado et al., 1954; Kaada and Ursin; 1957; De Molina et al., 1959), back and side ear positions (Kaada et al., 1953; Delgado et al., 1954; Kaada and Ursin, 1957; De Molina et al., 1959; Leyhausen, 1979), and pupil dilation (De Molina et al., 1959; Kaada and Ursin, 1957) were assessed given their association with cat fear and stress (Casey, 2002), and the presence of these responses with electrical stimulation of the cat amygdala and adjacent structures in the forebrain that are associated with fear and defensive reactions. Measures that are indicative of activation of the sympathetic nervous system were assessed since this has been widely associated with generalized fear responses in animals (Kreibig, 2010). Recent evidence suggests changes in sympathetic physiological responses (temperature, heart rate and respiratory rate) occur in cats during physical examinations (Belew et al., 1999; Niblett et al., 2015; Quimby et al., 2011). Lip licking was assessed since it has been found to occur during exposure to negative situations and stimuli, such as an unenriched shelter housing environment (Stella et al., 2014), during avoidance of a human (Gourkow and Phillips, 2016; Gourkow and Phillips, 2015), and may indicate pain or anxiety (Frank, 2014). Tail lashing was also assessed since it has been observed to occur in response to a fear-provoking stimulus (Watson, 1953), and with stimulation of areas
of the cerebellum that are thought to be associated with fear-related and affective processes (Dow and Moruzzi, 1958; Sacchetti et al., 2005). Cat responses that differed between the control and negative treatment were indicative of negative reactions to handling.

2. Materials and Methods

2.1 Animals

The current study used 51 non-pedigree cats, including 30 neutered males and 21 spayed females, from an animal shelter located in Ontario, Canada. Cat age ranged between 1 - 10 years old, with an average age of 4.8 (SD ± 2.8). At the time of testing, all cats had been housed in the shelter for a minimum of 7 d, were deemed healthy by a licensed veterinarian, and were available for adoption. Of the cats used, six (2 females, 4 males) had tested positive for feline immunodeficiency virus, but showed no clinical signs. All cats were singly housed, except two sibling pairs that were housed together. All animal procedures were approved by the University of Guelph’s Animal Care Committee.

If a cat showed attempts to bite or scratch during the experimental procedures, testing stopped and the cat was taken out of the study for the safety of the cat and the researchers. Four cats (3 males, 1 female) did not complete testing due to aggressive behavior.

2.2 Experimental Procedure

Experimental testing for each cat included the following two procedures: 1) an Unfamiliar Person Test, and 2) a mock veterinary examination. Testing for both procedures took place in a designated socialization room that was separate from the housing rooms. Testing took place during the light period between 9am – 5pm, for five consecutive days.

2.2.1 Unfamiliar Person Test

All animals underwent an Unfamiliar Person Test adapted from McCune (1995). This test included two phases, assessing willingness to approach a stranger, and response to an approaching stranger.
2.2.1.1 Experimental Set Up

All windows in the test room were covered with black out curtains (Model 49595, Mainstays Blackout Energy Efficient Grommet Curtain Panels, China) to ensure light levels remained consistent throughout testing, and to eliminate distractions from outside the room. The test area had a perimeter of 10.37 m (Fig. 4.1), and was enclosed using two canine exercise pens (0.61 m width x 1.2 m height; Gold Zinc Exercise Pen, Mid West® Homes for Pets, Munice, Indiana, USA). During the test, the unfamiliar person sat in a chair at one end of the enclosure, and the test cat within a carrier (61.2 cm length x 42.4 cm width x 36.8 cm height, Petmate® Ruff Maxx Kennel, 24 inch, Doskocil Manufacturing Company Inc., Arlington, Texas, USA), was placed two metres in front of the chair, at the other end of the enclosure. On the floor in front of the chair, a semi-circle at a 50-cm radius was outlined with duct tape (Duct Tape®, Shur Teck Brands, Avon Ohio, USA). The test area was fully swept between cats, and cleaned with all-purpose cleaner (Green Works, Clorox®, California, USA) at the end of each test day.

2.2.1.2 Testing

Researcher 1, the unfamiliar person, wore a white lab coat, while Researcher 2 wore a dark blue lab coat and acted as a research assistant. Immediately prior to testing the cat was removed from its home cage, placed into the pet carrier, and transferred to the test room. For Phase 1, the 2-min test period began when the research assistant opened the pet carrier door, moved out of view, and started a timer (Model 5826-21, Taylor Precision Products, USA). During this period, the unfamiliar person sat in the chair and did not move or make noise, and the cat was free to exit the carrier, explore the test area, and approach the stranger. If the cat had not exited the carrier by the end of this period, the research assistant took off the carrier lid, left the test area, and started the timer for one additional minute. During this minute, the cat could leave the carrier if it chose to.

In Phase 2, the unfamiliar person stood up out of the chair, approached the cat slowly while greeting it with a single ‘hi’, then crouched down towards the floor, stopped moving, and attempted to stroke the cat from head to tail three consecutive times. If the cat showed avoidance behaviour towards
the unfamiliar person (walked away, moved body and/or head away from the stranger), stroking was stopped. Immediately following completion of Phase 2, the research assistant carried the cat to another area within the test room for the next procedure.

2.2.2 Physical Examination

2.2.2.1 Experimental Set Up

The test area for the physical examinations was directly beside the area for the Unfamiliar Person Test. Examinations took place on a stainless steel mobile table (122 cm x 61 cm; Culinary Solution, Oakville, Ontario, Canada), with a blue rubber mat (43 cm x 91.4 cm, Model 090500, Rubbermaid®, Newell Rubbermaid, Oakville, Ontario, Canada) placed on top to minimize slipping. Researcher 1 (white lab coat) performed all handling, while Researcher 2 (dark blue lab coat) acted as a research assistant.

2.2.2.2 Testing

Cats were handled with one of two handling treatments: 1) passive restraint, or 2) full-body restraint (Table 4.1). Cats were blocked for sex and age using a matched pairs design then randomly allocated to treatment group. After the Unfamiliar Person Test was complete, the research assistant placed the cat on the examination table and the handler (Researcher 1) positioned the cat into restraint. The research assistant and handler stood at opposite sides of the examination table. If the handler had trouble getting the cat into restraint, the research assistant helped. The examination lasted for 2 min (after the cat was placed into the restraint) and proceeded in the following order: number of breaths observed over 15 s was recorded for respiratory rate, a stethoscope (Littmann Classic III, 3M Health Care®, St. Paul, Minnesota, USA) was used to assess the number of heart beats in 15 s, ear temperature was taken using an infrared ear thermometer (Model VT-150, Vet Temp®, Advanced Monitors Corporation, San Diego, California, USA), and three consecutive pictures of each eye were taken using a video camera (model HDR-CX330, Sony Corporation, China) for later analysis of pupil diameter. The infrared ear thermometer was chosen due to its minimal invasiveness, so that responses examined resulted from the restraint and not the process of taking the temperature reading. Since pupil dilation is sensitive to changes in light due
to the pupil light reflex (Woodhouse and Campbell, 1974), light-levels remained consistent throughout testing. Cats were released from restraint after 2 min and then assessed for an additional 1 min post-handling. The post-handling phase ended when the cat jumped off the table or the 1 min was up.

2.3 Data Collection

All experimental procedures were recorded for later behavioural scoring using a camcorder (Models HDR-CX220 and HDR-CX330, Sony Electronics, Corporation, China) in high definition recording mode. Observers were blind to treatment when scoring, but this was not possible when scoring behaviour during the restraint period since the restraint method was obvious. However, all observers were blind to the study hypotheses. Videos from the Unfamiliar Person Test were used to score cat behaviour to categorize cats as either friendly or unfriendly. Friendly cats had to satisfy the following two conditions: 1) voluntarily, completely exit the carrier and pass within the 50-cm semi-circle surrounding the chair where the unfamiliar person was sitting within 2 min, and 2) in one attempt, allow the unfamiliar person to approach and stroke three consecutive times. Cats that did not satisfy one or more of these conditions were categorized as unfriendly. Physical examination videos were used to score various cat behaviours (Table 4.2), during three phases of the examination: 1) placing the cat into restraint (starting when the research assistant placed the cat on the examination table in front of Researcher 1, and ending when the cat was correctly placed in its assigned restraint technique; Table 4.1), 2) restraint and physical examination (starting when the cat was correctly placed into the assigned restraint and ending 2 min later), and 3) post-handling (starting when Researcher 1 took both hands off the cat, and ending when the cat jumped off the examination table or when 1 min was up). During placement into restraint cats were assessed for: the number of attempts to place into restraint, duration of time to place into restraint, presence or absence of a side or back ear position at the 1 s mark, presence or absence of lip licking and struggling behaviour. During the examination phase, presence or absence of a side or back ear position was scored at the start of restraint, and every 5 s thereafter for 15 s, creating a score out of four for each cat. Tail lashing duration, number of vocalizations, and the number of lip licks were scored throughout
the entire 2 min duration of the examination. Lip lick data and the amount of time the cat’s face was out of view were used to calculate the number of lip licks per minute of time the cat’s face was in view. To calculate pupil dilation ratio, the clearest eye image for each cat was chosen and imported into ImageJ software, version 1.50a (developed by Wayne Rasband, National Institute of Health, Bethesda, Maryland, USA; available at https://imagej.nih.gov/ij/index.html). A pupil dilation ratio was calculated by averaging three measurements of the pupil and the iris diameter, then dividing the average pupil measurement by the average iris measurement. For the post-handling phase, ear position was scored 2 s after the handler let go of the cat. Tail lashing duration was scored for the entire duration of the post-handling phase (1 min), or until the cat jumped off the table.

The four cats that did not complete testing due to aggressive behaviour included two males that had been assigned to the full-body treatment, as well as one male and one female that had been assigned to the passive treatment.

2.4 Statistical Analysis

All analyses were conducted using SAS v.9.3 (SAS Institute, Cary NC, USA), with P values < 0.05 considered statistically significant. Models were built using a backward elimination process whereby the covariates (sex, age, friendliness) and restraint type were included in the model and then removed one at a time if P>0.05. Interaction variables based on all variables in the models were tested for inclusion.

Mixed linear regression was used to determine the associations between treatment and duration of time to place cats into restraint measured as the log transformation of time, heart rate, pupil dilation ratio during the examination, tail lash duration during and after the examination, and the latency to jump off the examination table measured as the logit transformation of the proportion of time cats spent on the table out of 1 min. Model fit was assessed using residual plots, histogram plots, Shapiro-Wilk normality test (alpha 0.05, P value < 0.05), the coefficient of determination, and AIC/BIC (with a lower value preferred).
Logistic regression was used to assess the association between treatment and the presence or absence of a side or back ear position, struggling, and lip licking during examination, as well as multiple attempts at restraint placement while placing the cat into the restraint. Model fit was assessed using the model chi-square statistic and predicative ability by examining changes in the coefficient of determination between models, with a larger coefficient preferred. Models were reduced down to a Fisher’s Exact test for struggling during placement into the restraint, presence of a side or back ear position post-handling, and whether or not the cat jumped off the table post-handling, as there was no evidence that other variables or interactions were significant in the model (P > 0.1).

Poisson regression was used to assess the number of lip licks per minute of time the cat’s face was in view during examination. Model fit was assessed using AIC/BIC and the Pearson chi squared statistic/degrees of freedom to assess over dispersion (>1).

A Fishers exact test was used to determine the association between treatment and the presence of vocalizations during the physical examination. A Cochran-Mantel-Haenszel chi-square test for ordinal variables was used to determine the overall association between treatment and side and back ear score during examination. A Mann Whitney Wilcoxon test was used to measure the effect of treatment on respiratory rate because respiratory rate was not normally distributed.

3. Results

3.1 Unfamiliar Person Test

Of the 47 cats included in the data set, 24 were categorized as friendly (N = 9 passive; N = 15 full-body), and 23 as unfriendly (N = 12 passive; N = 11 full-body. Friendly cats included 15 males and 9 females with an average age of 4.2 years old (SD ± 2.8; range 1-10 years). Unfriendly cats included 12 males and 11 females with an average age of 5.65 years old (SD ± 2.7; range 1-10 years).
3.2 Placing Cats into Restraint

Overall, it took longer to place cats into full-body restraint (median 10.40 s, 95% CI: 8.41, 12.86) in comparison to passive restraint (median 4.25 s, 95% CI: 3.35, 5.41; $F_{1,44} = 31.62$, $P < 0.0001$). There was a significant interaction between treatment and sex ($F_{1,44} = 4.40; P = 0.040$), with a larger effect observed in males (median 6.25 s, 95% CI: 5.10, 7.66) in comparison to females (median 7.09 s, 95% CI: 5.54, 9.07). Females took 1.75 (95% CI: 1.1, 2.9; $P = 0.030$) times longer to place into full-body restraint in comparison to passive restraint, whereas males took 3.45 (95% CI: 2.3, 5.0; $P < 0.0001$) times longer.

The odds of struggling was 8.2 (95% CI: 1.47, 58.53; $P = 0.009$) times greater in cats undergoing full-body restraint in comparison to passively restrained cats. Of those cats showing struggling behaviour, 13 underwent full-body restraint, and two underwent passive restraint. However, side or back ear position, lip licks, and number of attempts necessary to place a cat into restraint, did not differ between treatments during this phase.

3.3 Physical Examination

There was a significant interaction between treatment ($F_{1,43} = 5.19; P = 0.028$) and friendliness ($F_{1,43} = 0.01; P = 0.92$) when modeling pupil dilation ratio ($F_{1,43} = 8.39; P = 0.006$). Unfriendly cats undergoing full-body restraint showed a larger pupil dilation ratio than unfriendly cats undergoing passive restraint ($P = 0.0007$; Fig. 4.2). However, the pupil dilation ratio did not differ by treatment in friendly cats. In addition, unfriendly cats restrained using full-body restraint showed a larger pupil dilation ratio than friendly cats undergoing the same restraint technique ($P = 0.034$; Fig. 4.2).

Cats undergoing full-body restraint had a larger side and back ear score ($P < 0.0001$; Fig. 4.3), and an elevated respiratory rate ($P = 0.004$): cats had a median respiratory rate of 29 breaths per min for full-body restraint versus 18 breaths per min for passive restraint. Moreover, cats undergoing the full-body technique showed an average of 2.3 (95% CI: 1.8, 2.8) lip licks per min in comparison to an average of 1.5 (95% CI: 1.1, 2.0) lip licks per min in cats restrained with the passive technique ($F_{1,42} = 6.18; P = 0.017$). Heart rate, tail lashing, and presence of vocalizations, did not differ between treatments.
3.4 Post-handling

After the handler released the cat from restraint, the odds that the cat stayed on the examination table were 6.1 (95% CI: 1.04, 36.10; P = 0.0458; F_{1,44} = 4.23) times greater for cats restrained with passive restraint, in comparison to cats that underwent full-body restraint. On average, passively restrained cats stayed on the table for 42.2 s (95% CI: 11.7, 80.1), whereas after full-body restraint cats stayed on the table for 10.7 s (95% CI: 6.9, 16.2). In addition, female cats had a shorter latency to jump off the examination table than males (F_{1,44} = 24.04; P < 0.0001): females stayed an average of 8.7 s (95% CI: 3.3, 21.1), whereas males stayed for 47.9 s (95% CI: 25.8, 70.8). Seven cats (2 females, 5 males) stayed on the examination table for the entire 1 min period, all of which belonged to the passive treatment group. Side or back ear position, tail lashing, and whether a cat jumped off the table or not, did not differ between treatments.

4. Discussion

Validated methods for measuring cat fear and stress are needed to properly assess and improve cat handling methods for examinations and procedures. The current study compared cat responses during restraint using passive (control) and full-body (negative) restraint in friendly and unfriendly cats, and identified a number of behavioural and physiological measures that differentiate between the two treatments during placement into restraint, restraint and examination, and immediately after restraint.

On average, it took longer to place cats into full-body restraint in comparison to passive restraint. Passive restraint involves handling the cat in a normal upright position with minimal contact, whereas full-body restraint requires placing cats on their side and immobilizing their head, body, and limbs. Given the additional steps involved, it was expected that additional time would be required to perform the full-body restraint. In previous research cats have shown increased struggling behaviour during blood collection, as well as during and after a spray bath (Rand et al., 2002). A study by Lockhart et al. (2013) also found an increase in struggling behaviour during handling, and the response was greater when
handling was performed by an unfamiliar person, in comparison to a familiar person. This suggests that struggling may be have been reduced in the current study if the handler had been familiar to the cat. However, handling by an unfamiliar person is likely more relevant for restraint given that most handlers are often unfamiliar to cats during handling and restraint for examinations and procedures. Most of the cats showed struggling with full-body restraint but not with passive restraint, suggesting that this is a measure that differentiates between the two restraint techniques. In contrast to observations during the restraint phase, no significant treatment differences were detected for side or back ear position and lip licking while placing the cat into restraint. However, the time period for this was relatively short and this limited the possibility of observing these behaviours.

During the handling phase, cats undergoing full-body restraint showed a number of behavioural differences from passively restrained cats, including a greater number of lip licks, and more side and back ear positions. Lip licking in cats has been defined as an agonistic behavior in owned cats placed in a new environment with unpredictable noises (Stella et al., 2014), and as an anxious behaviour in individually caged shelter cats trying to avoid a human or when showing escape attempts within the cage environment (Gourkow and Phillips, 2016; Gourkow and Phillips, 2015). Furthermore, anecdotes suggest lip licking has been associated with negative responses during veterinary physical examinations (Frank, 2014). In recent literature, flattened and back ear positions have been interpreted as signs of fear in cats housed in catteries (Kessler and Turner, 1997), and during veterinary examinations (Nibblett et al., 2015). Our results support these interpretations, although our method of assessment of particular responses differed slightly. For example, the current study examined side and back ear positions, whereas Nibblett et al. (2015) used a more detailed scale that ranged from 1 to 5 (upright, upright but turned to sides, downward facing, flat back against head, moderately flattened). While our method differentiated between the two treatments, it is possible that the more detailed scale might have provided additional information about the level of response. Assessment of lip licking and ear position during handling are easy and practical.
responses for handlers to evaluate during handling, except maybe when special tools are being used such as a towel which may cover a cat’s head.

A review by Kreibig (2010) shows that activation of the sympathetic nervous system is useful when assessing fear responses, and indicates general arousal. Previous studies in cats have examined physiological changes (temperature, heart rate, and respiratory rate) during physical examinations by comparing responses in the home versus in the clinic. However, the results were inconsistent and studies have focused on different locations for examination (home versus clinic), instead of the handling itself (Belew et al., 1999; Nibblett et al., 2015; Quimby et al., 2011). One study showed that of 100 cats undergoing physical examinations, 30 were fearful, agitated, aggressive or dangerous, leading to 24 incomplete or unexaminable cats (Glardon et al., 2010). Negative responses during physical examinations may cause changes in physiological data (i.e. elevated blood glucose levels) that alter and complicate test results (Nibblett et al., 2015). In the current study, cats undergoing full-body restraint showed responses consistent with activation of the sympathetic nervous system, in comparison to passively held cats. Responses included higher respiratory rate and increased pupil dilation ratio, although we did not see an elevation in temperature and heart rate. Increased respiratory rate observed in the current study is likely an effect of fear during handling, and may also be related to increased physical activity from struggling that occurred more in full-body restraint cats.

Pupil dilation is not commonly included as a measure of cat fear or stress in recent cat handling research. When previous studies have assessed pupil dilation it has been through live scoring; for example Kronen et al. (2006) assessed pupil dilation during handling for catheterization in cats, using a three-point scale based on observer judgement. To the best of our knowledge the current study is the first to measure pupil dilation ratio from photographs. This approach is a more detailed, objective measure of pupil dilation, not influenced by other biases such as subjective interpretation and other behavioural responses which occur at the same time as live scoring. However, when put into practice, assessment of pupil dilation may be more difficult given that the handler would subjectively observe pupil dilation during
restraint. Thus, measurement of pupil dilation as used in the current study, may be more useful for research purposes. In the current study pupil dilation was larger in the full-body versus passive treatment for unfriendly but not friendly cats, suggesting this measure may be influenced by cat demeanor. We had no information about each cat’s level of socialization or previous handling experience, and this may have played a role in response differences seen. However, based on the premise of the Unfamiliar Person Test, unfriendly cats were less likely to approach and be approached and stroked by an unfamiliar person. Thus, we expected that unfriendly cats would show more negative responses to handling and restraint by an unfamiliar person.

Immediately after the handler let go of the cat, the cat could choose to either stay on the examination table, or jump off to the floor. Full-body restrained cats showed a shorter latency to jump off the examination table, in comparison to passively restrained cats. In addition, only 7 of the 47 cats chose to stay on the table, all of which were in the passive restraint group. There are two possible explanations for why the cats jumped off the table: either they were trying to escape from the handler and the area where restraint occurred, or for exploratory reasons. Our results suggest that cats chose to jump off the table to escape from the handler and handling environment, since if cats had escaped for exploratory reasons, more passively restrained cats would have jumped off the table and no significant differences between treatment groups would have been found. The results also showed that female cats had a shorter latency to escape, in comparison to male cats. To our knowledge, no research has assessed sex differences in defensive reactions in cats but our results suggest further research in this area is needed.

Many of the behaviours that were evaluated during full-body restraint were also observed at low levels during passive restraint. For example, during passive restraint some cats showed struggling, lip licking, side and back ear positions, and many of the cats jumped off the examination table when released from passive restraint. It is likely that passive restraint was negative for cats, but less so than full-body restraint. This finding suggests there was a bias towards the null hypothesis, which strengthens the study results given that this would have reduced the chance of seeing statistically significant results.
5. Conclusion

The current study provides the first scientific validation of responses to negative handling in cats. Measures that were increased with the full-body known negative condition, included struggling in response to being placed into restraint, as well as lip licking, side and back ear positions, increased respiratory rate, and pupil dilation ratio during examination. In addition, cats handled with the full-body restraint technique showed a shorter latency to escape immediately post-handling, in comparison to passively restrained cats. These measures can be used in future research to assess cat responses to common handling techniques used in various settings, such as veterinary clinics, animal shelters, and laboratory facilities. These validated parameters may also be used on a practical level to identify negative responses to routine handling in individual cats, which will allow handlers to adjust their techniques to minimize fear and stress.
References


Grandin, T., Shivley, C., 2015. How farm animals react and perceive stressful situations such as handling, restraint, and transport. Animals 5 1233-1251.


### Table 4.1 Descriptions of the restraint techniques used on cats during examinations.

<table>
<thead>
<tr>
<th>Restraint Technique</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive</td>
<td>The cat is held lightly with the least amount of restraint possible, in a position of the cats choosing (standing, sitting or laying). The cat is allowed movement of its head, body and limbs.</td>
</tr>
<tr>
<td>Full-body</td>
<td>The cat is held on its side with its back against the handler, while the handler grasps the front and back legs, with a forearm across the cat’s neck. The cat is allowed little to no movement of its head, body or limbs.</td>
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<tr>
<td>Phase</td>
<td>Response</td>
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<td>-----------------------</td>
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<tr>
<td>Placing cat into restraint</td>
<td>Attempts</td>
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<td></td>
<td>Struggling</td>
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<td></td>
<td>Lip lick</td>
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<td></td>
<td>Cat face out of view</td>
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<tr>
<td></td>
<td>Number of negative ear positions Side</td>
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<td></td>
<td></td>
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<tr>
<td>Examination</td>
<td>Lip lick</td>
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<tr>
<td></td>
<td>Cat face out of view</td>
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<tr>
<td></td>
<td>Number of vocalizations Meow</td>
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<td>Number of negative ear positions Side</td>
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<td></td>
<td>Tail lash duration</td>
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<tr>
<td>Post - handling</td>
<td>Tail lash duration</td>
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<td></td>
<td>Latency to jump</td>
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<td></td>
<td>Jump</td>
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<td></td>
<td>Number of negative ear positions Side</td>
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</tbody>
</table>
Figure 4.1 Diagram of the Unfamiliar Person Test area
**Fig. 4.2** Mean (± S.E.) pupil dilation ratio for cats categorized as friendly and unfriendly undergoing passive (n = 22) or full-body (n = 25) restraint based on the output of a linear regression model.

* denotes significance at P < 0.05
Fig. 4.3 More cats showed higher negative ear scores during full-body restraint ($n = 25$) in comparison to passive restraint ($n = 22$; Cochran-Mantel-Haenszel chi-square test; $P < 0.0001$).
Chapter 5: Getting a Grip: Cats Respond Negatively to Scruffing and Clips

Abstract

Scruffing is routinely used for handling and restraining cats, and in recent years scruffing tools (example: binder clips, clipnosis® clips) have been introduced as a potential alternative. These techniques are intended to immobilize cats, but using scruff and clip restraint is contentious and cat handling guidelines vary in recommendations regarding these techniques. The current study examined whether cats show negative responses to the following restraint methods: 1) scruff (n=17), 2) clip (two clips applied to the dorsal neck skin; n=16), and 3) full-body (known negative; n=19); each cat was also handled with passive restraint (control) for comparison. Before testing all cats were categorized as friendly or unfriendly based on their interactions with a stranger. During handling, cats were examined for behavioural (side and back ear positions, vocalizations, lip licking) and physiological (pupil dilation ratio, respiratory rate) responses. Cats restrained with full-body techniques showed more negative responses than passive (respiratory rate P=0.006; $F_{3,37}=4.31$, P=0.01; ear P=0.002; $F_{3,49}=6.70$, P=0.0007, pupil P=0.007; $F_{3,95}=14.24$, P=0.004, vocalizations P=0.009; $F_{3,49}=4.85$, P=0.005) and scruff restrained cats. Clip restraint caused more negative responses than passive (pupil P=0.01, vocalizations P=0.007, ear P=0.02) and scruff restraint (pupil P=0.01, vocalizations P=0.02). No treatment differences were detected between full-body and clip-restrained cats; and no effects interacted with cat friendliness. Full-body restraint resulted in the highest number of negative responses, followed by clip restraint, with fewer responses observed in scruff, and the least observed in passively-restrained cats. Thus, it is recommended that the use of full-body, clip and scruff restraints are avoided when possible.
1. Introduction

Laboratory, shelter and owned cats are handled and restrained for many reasons, including routine health examinations, necessary diagnostic procedures, and medication administration. In the past, use of handling methods that either partially or fully immobilized a cat were considered necessary to ensure handler safety (Rodan, 2010). However, it is widely known that manual full-body restraint is a psychological stressor: immobilization by manual restraint evokes fear (Grandin, 1997), escape behaviour (struggling; Adolphs, 2013; Archer, 1979), and elicits sympatho-adrenal activation (Abercrombie and Jacobs, 1987). Immobilization has also been used to elicit a stress response in a variety of research species (Buynitsky and Mostofsky, 2009), including studies involving cats (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993).

Recent evidence suggests that fear and aggressive behaviour are displayed by cats during routine handling during veterinary visits (Glardon et al. 2010; Mariti et al. 2016), suggesting that veterinary handling can directly impact cat welfare. Moreover, challenges with cat handling during examination may lead to difficulties with diagnoses and treatment, and negatively affect cat health (Glardon et al., 2010; Mariti et al., 2016; Rodan, 2010). Additional stress due to poor handling is also a welfare concern for shelter and laboratory cats, given that shelter cats are already exposed to a novel and potentially stressful environment, and poor handling may negatively influence the quality and reliability of laboratory cat research results.

Scruffing involves grasping a cat's skin and fur at the back of the neck using one hand held in a fist. Scruffing tools (example: binder clips, clipnosis clips) perform the same function as scruffing, bringing together the fur and skin on the back of a cat’s neck, resulting in a constant pressure. Clips have been recently introduced into veterinary clinics for use during handling and restraint, although have been previously used in a variety of species (including cats), to induce an immobilization response in a laboratory setting (Monassi et al., 1990). Generally, this restraint method involves applying one or two specifically designed clips (e.g., Cat scruffier clip, Campbell pet company, Washington; Clipnosis®
gentle calming clip™, Fairport Harbor, OH) or 2-inch binder clips (Herron and Shreyer, 2014; Pozza et al., 2008; Nuti et al., 2016), to the loose skin at the back of the cat’s neck. Some have suggested that this pressure elicits a dorsal immobility reflex, and is associated with a calming effect (Pozza et al., 2008).

Applying pressure in the dorsal neck area has been previously used in laboratory species (mice, rats, rabbits, cats) to imitate carrying of immature animals, and physical restraint during predation, and is thought to induce an immobilization response referred to as the dorsal immobility reflex (Monassi et al., 1990). In nature, this anti-predatory behaviour is thought to be beneficial to young animals to facilitate carrying, and to prey species to help reduce the risk of continued attack (Monassi et al., 1990). Cats naturally exhibit immobilization when carried by their mother as a kitten and during mating when the male grips the neck of the female by the mouth (Hart and Hart, 2014). The functionality of scruffing in these specific situations, have been employed to justify the use of scruffing and clips during cat handling. Authors suggest that the dorsal immobility reflex in mice is associated with a physiological effect that induces both immobility and a calming effect (Fleishmann and Urca, 1988); this has not been examined in cats.

Current cat-handling guidelines recommend reducing negative experiences by using minimal restraint and alternative techniques as opposed to full-body immobilization (Anseeuw et al., 2006; Carney et al., 2012; Hammerle et al., 2015; Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Rodan, 2010; Yin, 2009). The use of clips and scruffing on pet cats is contentious, with guidelines varying in recommendations. Some recommend against the use of scruffing and clips altogether (Anseeuw et al., 2006; Hammerle et al., 2015; Rodan, 2010), suggesting that the use of scruffing on low-arousal cats is inappropriate (Hammerle et al., 2015), and that by avoiding scruff restraint, handling will be easier and keep the cat calmer (Rodan, 2010). Other guidelines conditionally recommend scruffing and scruffing tools on a case-by-case basis, on cats that are not overly reactive (struggle, vocalize) during restraint (Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Yin, 2009). One cat handling guideline suggests that scruffing should not be used routinely, and instead, it should be used only when no
alternative exists (Rodan et al., 2011). Another handling guideline seems to recommend the use of clips over manual scruffing; suggesting that clips provide stronger, more consistent, and evenly distributed pressure than manual scruffing, and that scruffing does not provide the same behavioural calming as clips (Herron and Shreyer, 2014). Overall, recommended use of scruffing and clips on cats remains divided, with some recommending against use (Anseeuw et al., 2006; Hammerle et al., 2015; Rodan, 2010,) and others suggesting use on a case by case basis (Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Yin, 2009). Little scientific research has examined the cat welfare implications regarding the use of clips or scruffing on cats.

To date, only two studies have examined cat responses to clips or scruffing; both have used a Likert scale to assess behavioural inhibition, indicated by spontaneous or manual acceptance of a lateral decubitus position, during application. (Pozza et al., 2008; Nuti et al., 2016). These studies suggest that most cats undergo behavioural inhibition with clip restraint (Nuti et al., 2016; Pozza et al., 2008). One study also found that cats restrained by scruffing had a higher heart rate and pupil dilation than clip-restrained cats (Nuti et al., 2016); however, the authors did not validate responses used to assess cat responses during handling. Although increased physiological responses indicate greater sympathetic activation and have been previously associated with fear (Kreibig, 2010), these measures do not provide information on valence (positive or negative) of a stimulus, and thus are not good indicators of affect without evidence that specifies valence.

The current study used previously validated behavioural (back and side ear positions, lip licking) and physiological (pupil dilation, respiratory rate) responses indicative of negative affective states during handling (Moody et al., 2018) to examine cat responses to: 1) scruffing, 2) clips, and 3) full-body (known negative; n=19) restraint. In addition, all cats were also assessed during a passive restraint technique, which was used as a neutral control for comparison. During and after handling, negative vocalizations (growling, hissing, meowing) were also examined given increased vocalizations; fear and defensive responses have been seen in cats during electrical stimulation of the amygdala and adjacent structures in
the forebrain (Kaada et al., 1953; Delgado et al., 1954; Kaada and Ursin; 1957; De Molina et al., 1959), providing supporting rationale for assessment of this particular measure. After handling, cats were also examined for attempted avoidance behaviour (walking or backing away from the handler); avoidance has been used to assess aversive experiences and is known to be associated with fear and acute stress in animals (Adolphs, 2013; Archer, 1979).

Before testing, all cats underwent an Unfamiliar Person Test (adapted from McCune, 1995), used to categorize them as either friendly or unfriendly based on a cat’s willingness to approach, and be approached and pet by a stranger. This test was performed given that cat responses to an unfamiliar person vary, and are influenced by factors such as genetics, past handling experiences (Collard, 1967; Karsh, 1984, 1983; Wilson et al., 1965), and socialization experiences (Grandin and Shively, 2015; Reisner et al., 1994). We hypothesized that cats categorized as unfriendly would find all handling aversive in comparison to friendly cats, and that handling treatments would differ in aversiveness to cats.

2. Materials and Methods

2.1 Animals

The current study used 55 non-pedigree shelter cats, including 22 neutered males and 33 spayed females, from an animal shelter located in Ontario, Canada. At the time of testing, all cats had been housed in the shelter for at least 5 d, were singly housed, and deemed healthy by a licensed veterinarian. All animal procedures were approved by the University of Guelph’s Animal Care Committee.

Of the 55 cats included in the study, 2 females displayed aggressive behaviour during restraint and were removed from the study; both had been assigned to the full-body treatment group. In addition, one male (clip treatment group) was discovered to have a urinary tract infection at the time of testing, and his data were removed from the study. Thus, 53 cats were included in the final data set: 21 males and 31 females, with an average age of 4.6 (SD ± 2.4) and range of 1-10 years old.
2.2 Experimental Procedure

Experimental testing for each cat included the following two test procedures, which were performed consecutively: 1) an Unfamiliar Person Test, and 2) restraint. Testing for both procedures took place in the shelter’s clinic, located in a separate building from where the cats were housed. Testing took place during the light period between 9am – 6pm, over a period of 7 days.

2.2.1 Unfamiliar Person Test

An Unfamiliar Person Test adapted from McCune (1995) was used to categorize cats as either friendly or unfriendly based on their responses to a stranger. Testing consisted of two phases: 1) willingness of the cat to approach a stranger, and 2) responses to being approached and pet by a stranger. The experimental set up (Fig. 5.1) and procedure used are identical to that of section 2.2.1. of Moody et al. (2018; Thesis Chapter 4), except that testing took place in a room with a perimeter of 9.49 m.

2.2.2. Restraint

Cats were restrained on a table (Lifetime® Utah, USA; 178 cm length x 76.2 cm width x 91.4 cm height), with rubber mats (43 cm x 91.4 cm, Model 090500, Rubbermaid®, Newell Rubbermaid, Oakville, Ontario, Canada) to minimize slipping. Three research personnel were present during testing: the main investigator performed all handling, and two research assistants moved cats through the different stages of testing, assisted with restraint when necessary, and collected video recordings and physiological measures.

2.2.2.1 Procedure

All cats were restrained with passive restraint, and restrained with one of the three other restraint techniques (full-body, scruff, clip) for comparison; order of restraint was counter-balanced between cats. Cats were restrained for 1-min, during which respiratory rate (number of breaths seen in 15 seconds) was recorded, and three consecutive pictures of each eye were taken using a video camera (model HDR-CX330, Sony Corporation, China) for later assessment of pupil diameter. After 1 min was up, the handler released the cat from restraint and took a step back from the table. The cat was left on the table for 30
seconds, for later analysis of post-handling behaviour. The cat then underwent restraint with a second handling technique. This procedure was repeated until the cat had been restrained twice with each of two different restraint techniques.

2.3 Data Collection

A camcorder (Models HDR-CX220 and HDR-CX330, Sony Electronics, Corporation, China) was used to record all experimental procedures in high definition recording mode for later behavioural scoring. Observers were blind to treatment and cat friendliness when scoring, but this was not possible when scoring behaviours during the restraint period since the restraint method was obvious. However, all observers were blind to the study hypotheses.

Videos from the Unfamiliar Person Test were used to score cat behaviour to categorize cats as either friendly or unfriendly based on interactions with an unknown person. Friendly cats satisfied the following two conditions: 1) within 2 min, completely exited the carrier voluntarily and passed within the 50-cm semi-circle surrounding the chair where the unfamiliar person was sitting, and 2) allowed the unfamiliar person to greet, approach, and stroke the cat three consecutive times on the first attempt. Cats that did not satisfy one or more of these conditions were categorized as unfriendly.

Videos were used to score various cat behaviours (Table 5.2; Moody et al., 2018), during 1) restraint (starting when the cat was correctly placed into the assigned restraint and ending 2 min later), and 2) post-handling (starting when the handler took both hands off the cat and ending when 30 seconds was up). During restraint, the presence or absence of a side or back ear position was recorded; it was scored at the start of restraint and every 5 s thereafter for 15 s, creating an ear score out of four for each cat. Number of vocalizations, and number of lip licks were scored throughout the entire 2 min duration of the restraint. Lip lick data and the amount of time the cat’s face was out of view were used to calculate the number of lip licks per minute of time a cat’s face was in view. To calculate pupil dilation ratio, the clearest eye image for each cat was chosen and imported into ImageJ software, version 1.50a (developed by Wayne Rasband, National Institute of Health, Bethesda, Maryland, USA; available at
A pupil dilation ratio for each cat was calculated by averaging three measurements of the pupil and the iris diameter, then dividing the average pupil measurement by the average iris measurement. For cats undergoing clip restraint, cats were assessed for whether they spontaneously went into a hunched lateral decubitus position, as this has previously been used to examine effectiveness of the dorsal immobility reflex (Nuti et al., 2016).

For the 30 second post-handling phase, ear position was scored once 2 s after the handler let go of the cat, and vocalizations, walking or backing away from the handler, and number of lip licks (taking into account the amount of time a cat’s face was in view of the camera), were assessed over the entire period.

2.4 Statistical Analysis

All analyses were conducted using SAS v.9.3 or SAS University Edition 2016 (SAS Institute, Cary NC, USA), with P values < 0.05 considered statistically significant. Each cat was handled with two handling treatments (passive restraint and either full-body, scruff, or clip), therefore cat identification was included as a random effect in all models that included paired data. Models were built using a backward elimination process whereby the covariates (sex, age, friendliness) and restraint type were included in the model and then removed one at a time if P>0.05. Interaction variables based on all variables in the models were tested for inclusion. When analyzing the number of lip licks out of the time the cat’s face was in view, a logit transformation was performed since the data were presented as a percentage of time, and there was a limit on the amount of time a cat was examined.

Mixed linear regression was used to determine the associations between treatment and respiratory rate, and pupil dilation ratio. Model fit was assessed using residual plots, histogram plots, Shapiro-Wilk normality test (alpha 0.05, P value < 0.05), the coefficient of determination, and AIC/BIC (with a lower value preferred).

Binomial logistic regression was used to assess the association between treatment and ear score (out of 4) during handling, while binary logistic regression was used to assess the association between treatment and presence of a side or back ear position, and whether or not the cat walked away from the
handler towards the back of the compartment during the post-handling phase. Model fit was assessed by fitting all the interactions and terms available into the model to see if they were significant and explained the data.

Poisson regression was used to assess the number of vocalizations during handling, and the number of lip licks (per minute of time the cat’s face was in view) during the handling and the post-handling phase. Model fit was assessed by fitting all the interactions and terms available into the model to see if they were significant and explained the data, in addition to using the Pearson chi squared statistic/degrees of freedom to assess over dispersion (>1).

A Pearson Chi-square exact test was used to examine the association between treatment and vocalizations during the post-handling phase, due to a small number of positive responses in this data set. This test was used to examine if there was an overall difference in the proportion of cats vocalizing between treatments, examining all treatment combinations separately.

3. Results

3.1 Unfamiliar Person Test

Thirty-nine cats were categorized as friendly (N=14 full-body; N=15 scruff; N=10 clip), and 13 categorized as unfriendly (N=5 full-body, N=2 scruff; N=6 clip), out of the 52 cats that were included in the full data set. The average age of the friendly cats was 4.5 years old (SD ± 2.4; range 1-10 years), while unfriendly cats had an average age of 4.9 years old (SD ± 2.3; range 1-10 years). There were 16 males and 24 females included in the friendly category, and 7 males and 6 females included in the unfriendly cat category.

3.2 Restraint

On average, cats undergoing full-body restraint showed more breaths per min (mean number of breaths per min: 52.46, 95% CI: 46.7, 58.9) than cats undergoing passive restraint (mean number of
breaths per min: 44.77, 95% CI: 41.2, 48.7; P=0.006). No other significant treatment effects were seen when analyzing respiratory rate.

Cats undergoing passive restraint showed smaller pupil dilation ratios (F$_{3,95}$ = 14.24; P = 0.004; Fig.5.2) than cats undergoing full-body (P = 0.007) and clip (P = 0.01) restraint. In addition, cats undergoing scruff restraint showed smaller pupil dilation ratios than cats undergoing full-body (P=0.009) and clip (P = 0.01) restraint. A sex by friendliness interaction was also seen, with unfriendly female cats (mean 0.59, 95% CI: 0.53, 0.65; F$_{1,95}$ = 5.71; P = 0.019) showing larger pupil dilation ratios than friendly female cats (mean 0.46, 95% CI: 0.42, 0.50; P < 0.0001), and friendly and unfriendly male cats (mean 0.47, 95% CI: 0.43, 0.51; P = 0.0006 and mean 0.49, 95% CI: 0.44, 0.55; P = 0.01, respectively); no differences were detected between friendly and unfriendly male cats.

In comparison to passively-restrained cats, there was a greater rate of vocalizing in cats undergoing full-body (rate ratio: 3.38, 95% CI:1.39, 8.26, P=0.009; F$_{3,49}$=4.85, P=0.005; Fig.5.3) and clip restraint (rate ratio: 4.45, 95% CI: 1.53, 12.94, P=0.007). Cats held with the scruff restraint showed a lower rate of vocalizations in comparison to full-body (rate ratio: 0.15, 95% CI:0.025, 0.88; P=0.04) and clip (rate ratio: 0.11, 95% CI: 0.018, 0.72; P=0.02) restrained cats; no differences were detected between scruff and passively restrained cats.

The odds of having a higher ear score (more side and back ear positions) was greater in cats restrained with a full-body (odds ratio: 2.98, 95% CI: 1.51, 5.88; P=0.002; Fig. 5.4), clip (odds ratio: 2.27, 95% CI: 1.13, 4.55; P=0.02), or scruff (odds ratio: 2.89, 95% CI: 1.34, 6.21; P=0.008) handling technique in comparison to being restrained with passive handling, respectively. No differences were detected between the other restraint techniques.

On average, the number of lip licks per minute was greater in passively restrained cats (mean: 1.13, 95% CI: 0.81, 1.6; F$_{3,48}$= 3.29, P=0.03) than cats held with a scruff restraint (mean: 0.34, 95% CI: 0.15, 0.82; P=0.009). In addition, female cats showed a greater number of lip licks per minute (mean:1.0,
95% CI: 0.67, 1.5; P=0.02) than males (mean: 0.47, 95% CI: 0.28, 0.80), regardless of handling treatment.

During handling with clip restraint, 4 of 16 cats (2 female: friendly; 2 males:1 friendly, 1 unfriendly; 25%) spontaneously went into a hunched lateral decubitus position, while 11 of 16 cats (68.75%) lay ventrally with a hunched posture and lowered head towards the table, and 1 cat (male friendly, 6.25%) stood; it is unknown whether this was by choice or involuntary. No cats in any of the other treatment groups showed a spontaneous hunched lateral decubitus position.

3.3 Post-handling

The odds of showing lip licking was 2.36 (95% CI: 1.22, 4.54, P=0.01; F1, 48=6.92, P=0.01) times greater in females in comparison to males (female mean: 2.3, 95% CI: 1.54, 3.45 versus male mean: 0.98, 95% CI: 0.55, 1.75). Age showed a quadratic two-way interaction (F1,49=6.51, P=0.01); as age increases so does the number of lip licks per minute until reaching an average maximum of 1.5 lip licks per minute at age 6, followed by a decline with increasing age. No treatment effects were detected when analyzing lip licking post-handling in cats.

More cats vocalized after being handled with full-body versus passive restraint (P=0.03). No treatment effects were detected when analyzing vocalizations, the presence of a side or back ear positions, or whether a cat walked away from the handler towards the back of the compartment.

4. Discussion

Cats restrained with the full-body technique showed more negative responses (respiratory rate, ear score, pupil dilation ratio, vocalizations) than passive-restrained cats, as did cats restrained by the scruff (pupil dilation ratio, vocalizations). Overall, clip-restrained cats showed similar responses to cats undergoing full-body restraint, with no significant differences detected between the behavioural and physiological parameters that were scored. Moreover, scruff-restrained cats showed fewer negative responses than both full-body and clip-restrained cats (pupil dilation ratio, vocalizations), suggesting this
handling technique may be less negative than restraint with full-body or clips. However, scruffed cats showed a larger ear score than passively-restrained cats, suggesting that scruffing is more negative than passive restraint. Thus overall these data suggest that the negative welfare impact of these techniques are: full-body = clip > scruff > passive.

There are many differences between the current study, and past studies assessing cat responses to clip and scruff restraints. Previous studies assessing cat responses to binder clips reported that 92% (Pozza et al., 2008) and 81.5% (Nuti et al., 2016) showed a lateral decubitus position. Although the current study did not attempt to place cats into a lateral decubitus position, few cats showed this position spontaneously, while the majority chose to lay ventrally with a hunched posture and a lowered head. This difference may be due to the type of clips used in the current study, as we used two specifically designed Clipnosis® clips, placing the clips on the dorsal neck skin for 1 minute. In contrast, Nuti and colleagues (2016) placed two 2-inch binder clips on the dorsal neck skin for 2-5 min during performance of routine veterinary procedure, and the other study also used two 2-inch binder clips on the dorsal neck skin but did not specify the duration of application; authors indicated that rankings of cat responses were completed immediately after the clips were applied (Pozza et al., 2008). Differences in pressure between Clipnosis® clips and 2-inch binder clips, as well as the effects of different durations of application are unknown.

The current study results show that clip restraint results in more negative responses (pupil dilation ratio, vocalizations) than scruff restraint, which conflicts with previous research suggesting that clip restraint is less stressful than scruffing based on changes in pupil dilation and heart rate (Nuti et al., 2016). The current study did not assess heart rate given that a previous study validating cat responses to full-body versus passive restraint did not find this was a sensitive indicator of negative affect (Moody et al., 2018). However, detailed pupil assessment was completed and our findings were opposite to this previous research, and supported by a concomitant increase in vocalizations. In the current study, direct measurements were taken from photographs, whereas past studies have used subjective scores from live observer assessment; the latter may be biased by lack of blinding and the influence of other behavioural
responses which occur at the same time as scoring, which might account for the difference. Pozza and colleagues (2008) did not examine specific indicators of cat affective state, but suggest that the resulting posture (lateral decubitus position with a hunched back and tail tucked) from clip placement was not a fear response because cats remained responsive, in an alert posture. However, past literature suggests that a hunched posture may be associated with fear (Roberts, 1958; Kessler and Turner, 1997), and a tail wrapped close to the body has been associated with a stress response in cats (McCune, 1995). In addition, the current results suggest that cats showed similar negative responses during clip and full-body restraint, indicating negative affect is associated with the use of clips.

One other major difference between the two studies was the method of selecting cats for treatment groups. Cats in the current study were assigned randomly to treatment, and were blocked by categorization as either unfriendly or friendly based on interactions with a stranger to minimize potential group differences. In contrast, Nuti and colleagues (2016) placed cats into the clip group only if the owner gave consent. If no consent was provided, the cat was placed into the scruff group. Since no formal assessment of cat demeanor or interactions with the veterinarian were included in the study, it is possible that some bias existed in the clip group. For example, if the owner knows the cat has responded poorly to handling during previous appointments, they may be more likely to decline the use of clips, resulting in the clip group having calmer, or less reactive cats than the scruff group. An alternative explanation is that the Clipnosis® clips used in the current study might induce increased pain or discomfort in comparison to the binder clips used in previous research, suggesting further research is needed to compare these two methods of application.

In previous research, we assessed response differences between cats handled with full-body and passive restraint, and identified and validated the following negative responses during handling: more side/back ear positions, higher respiratory rate, larger pupil dilation ratio, and greater number of lip licks (Moody et al., 2018). Most of these original response differences were replicated in the current study between full-body and passively restrained cats; cats did not show a significant difference in lip licking
when undergoing full-body versus passive restraint. In addition, cats in the current study showed an increase in vocalizations when handled with full-body restraint: a difference not observed in our original validation. Overall these findings suggest that some of our response measures are more consistent and reliable than others. While pupil dilation, respiratory rate and ear position were consistent in both studies, lip licking and vocalizations appear to vary with the sample of animals. Thus, these measures might be influenced by other developmental or environmental variables that were not recorded, such as genetics or background fear and stress levels. In the current study regardless of handling treatment, lip licking was seen more in females than male cats during the handling and post-handling phases. In addition, there was also an age effect, with more lip licking seen as age increased up to 6 years old, followed by a decline in older cats; sex and age influences were not seen in our original validation study. In future studies, results for lip licking and vocalizations should be interpreted with caution, particularly if a passive control and full-body negative treatments are not included as controls.

One unexpected finding was that the number of lip licks seen during handling was greater in passively-restrained cats in comparison to scruff-restrained cats. This finding is inconsistent with other treatment results, as passively-restrained cats showed fewer negative responses than scruff-restrained cats. One possible explanation for the discrepancy of results is that scruffing might restrict the performance of lip licking in cats; the loose skin of the neck is pulled back tightly during scruffing, possibly affecting opening of the mouth: a hypothesis that should be tested in future work.

5. Conclusion

Overall, clip restraint with Clpnosis® clips resulted in similar responses to our known negative treatment, full-body restraint, and it also caused more negative responses than passive and scruff restraint (inferred from pupil dilation ratio, and vocalizations). Scruff-restrained cats showed more negative responses than passively restrained cats (ear position), but less negative responses than caused by clip-(pupil dilation ratio, vocalizations) and full-body (pupil dilation ratio, vocalizations) restraint. This
suggests that handling with clips, as well as scruffing to a lesser degree, are negatively perceived by cats. Thus, it is recommended that the use of clip and scruff restraints is avoided when possible. However, when some level of cat immobilization is necessary, scruff may be preferable to clip and full-body restraint since its use resulted in fewer negative responses.
References


Grandin, T., Shivley, C., 2015. How farm animals react and perceive stressful situations such as handling, restraint, and transport. Animals. 5, 1233-1251.


Table 5.1 Ethogram for the examination and post-handling phases of the restraint procedures, that were examined for all cats undergoing restraint.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Response</th>
<th>Definition and validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
<td>Lip lick</td>
<td>Number of times the tongue licks lips and/or nose</td>
</tr>
<tr>
<td></td>
<td>Cat face out of view</td>
<td>Duration of time the cat’s face is out of view and lip licks cannot be observed</td>
</tr>
<tr>
<td></td>
<td>Number of vocalizations</td>
<td>Typical cat “meow” sound</td>
</tr>
<tr>
<td></td>
<td>(Stanton et al. 2015)</td>
<td>Number of observations with side and back ear positions</td>
</tr>
<tr>
<td></td>
<td>Meow</td>
<td>Sound produced with a closed mouth, consisting of a throat, low pitch rumbling sound</td>
</tr>
<tr>
<td></td>
<td>Growl</td>
<td>A long, drawn-out sound of variable pitch, intensity, duration and tonality</td>
</tr>
<tr>
<td></td>
<td>Yowl</td>
<td>A drawn-out hissing sound with low intensity produced by rapid expulsion of air from the cat’s mouth</td>
</tr>
<tr>
<td></td>
<td>Hiss</td>
<td>At least one ear pinna points outward to the side of the head, and ears may or may not be folded or held close to head</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>Ears are flat and point towards the rear of the head</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td></td>
</tr>
<tr>
<td>Post-handling</td>
<td>Presence of a side or back ear position</td>
<td>Meow, growl, yowl, or hiss (See above for definitions)</td>
</tr>
<tr>
<td></td>
<td>Lip lick</td>
<td>See above</td>
</tr>
<tr>
<td></td>
<td>Cat face out of view</td>
<td>See above</td>
</tr>
<tr>
<td></td>
<td>Walk or backs away</td>
<td>Walks or backs away from handler towards the back of the compartment</td>
</tr>
</tbody>
</table>

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Table 5.2 Descriptions of the four restraint techniques used on cats to examine negative cat responses to handling

<table>
<thead>
<tr>
<th>Restraint Technique</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive</td>
<td>The cat is held lightly with the least amount of restraint possible, in a position of the cat’s choosing (standing, sitting or laying). The cat is allowed movement of its head, body and limbs.</td>
</tr>
<tr>
<td>Full-body</td>
<td>The cat is held on its side with its back against the handler, while the handler grasps the front and back legs, with a forearm across the cat’s neck. The cat is allowed little to no movement of its head, body or limbs.</td>
</tr>
<tr>
<td>Scruff</td>
<td>The cat’s skin and fur at the back of the neck is grasped tightly using one hand and held in a fist. The cat is restrained allowing minimal movement of the body and limbs</td>
</tr>
<tr>
<td>Clip</td>
<td>Use of two clips applied to the dorsal neck area that brings together the skin and fur at the back of the cat’s neck while applying a consistent firm pressure</td>
</tr>
</tbody>
</table>
Figure 5.1 Diagram of the Unfamiliar Person Test area
Figure 5.2 Pupil dilation ratio for cats undergoing passive, full-body, clip or scruff restraint. A larger pupil dilation ratio was detected in cats restrained with full-body (P=0.007) and clip (P=0.01) restraint in comparison to passive restraint. Cats undergoing scruff restraint showed a smaller pupil dilation than full-body (P=0.009) and clip (P=0.01) restrained cats. (Mixed Linear Regression).
Figure 5.3 The mean number of vocalizations per minute for cats undergoing passive, full-body, clip or scruff restraint. A greater number of vocalizations per minute was detected in cats restrained with full-body (P=0.009) and clip (P=0.007) restraint in comparison to passive restraint. Cats undergoing scruff restraint showed a lower number of vocalizations per minute in comparison to full-body (P=0.04) and clip (P=0.02) restrained cats. (Poisson Regression)
Figure 5.4 Ear score out of 4 (score of 4 indicating the highest negative affect), for cats when undergoing passive, full-body, clip or scruff restraint. More cats showed a larger ear score when restrained with a full-body ($p=0.002$), clip ($p=0.02$) or scruff ($p=0.008$) restraint, in comparison to being restrained with passive handling. (Binomial logistic regression).
Chapter 6: General Discussion

1. Overview

Owned, shelter, and laboratory cats all undergo routine handling for examinations and procedures throughout their lifetime. During handling for examinations, cats show signs of fear and stress (Glardon et al., 2010; Mariti et al., 2016; Dawson et al., 2018), and this is a welfare concern. In addition, handling difficulties may result in challenges with examinations, with the potential for inaccurate diagnoses and treatments (Glardon et al., 2010; Rodan, 2010). Injuries to the cat or handler may also occur, as cat bites and scratches during handling are one of the most common animal related injuries for small animal clinic staff (Fowler et al., 2016; Jeyaretnam and Jones, 2000; Gibbins and MacMahon, 2015; Nordgren et al., 2014; Nienhaus et al., 2005). In Canada and the USA, cat visits to the veterinary clinic have been declining since 2001 (Gauvin, 2015; Volk et al. 2011, Volk et al. 2014; Osborne 2010), with stressful experiences as a major reason why cat owners are not bringing their cats to the clinic (Volk et al., 2014; Griffith et al., 2000; Quimby et al., 2011; Belew et al., 1999; Cauvin et al., 2003; Glardon et al., 2010; Mariti et al., 2016).

Many low-stress cat handling guidelines (Anseeuw et al., 2006; Carney et al., 2012; Hammerle et al., 2015; Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Rodan, 2010; Yin, 2009) and initiatives (American Association of Feline Practitioners (AAFP) Cat Friendly Practice® program, Dr. Sophia Yin’s Low Stress Handling® University, and the Fear-Free™ program) have been developed during the last 15 years. These guidelines focus on reducing negative experiences and increasing positive ones for both cats and owners. One of the key recommendations that have come out of these guidelines and initiatives, is to reduce or completely avoid the use of manual full-body immobilization techniques for restraint. The rationale provided for this recommendation is that these methods likely induce negative affective states such as fear, and can lead to aggressive behaviour, however this had not been tested prior to this thesis. Full-body immobilization has been demonstrated to induce stress responses and aversion in
animals; it is used to model behavioural and physiological stress responses in a variety of species (Buynitsky and Mostofsky, 2009), including cats (Abercrombie and Jacobs, 1988; Wilkinson and Jacobs, 1988; Willemse et al., 1993). If it is not possible to handle a cat using passive or minimal restraint techniques, guidelines suggest alternative restraint tools such as loose towels and towel wraps (head in, head-out). Other handling tools exist, such as cat muzzles and cat bags, however guidelines vary in their recommendations of use. Restraint using scruffing or scruffing tools is contentious, with some recommending use on a case-by-case basis (Herron and Shreyer, 2014; Lloyd, 2017; Rodan et al., 2011; Yin, 2009), and others suggest these techniques should not be used at all (Anseeuw et al., 2006; Hammerle et al., 2015; Rodan, 2010).

Until my thesis, there had been little scientific evidence to support current restraint recommendations, and the few data that existed had not used well-validated methodologies when examining cat responses to restraint (Nuti et al., 2016; Pozza et al., 2008). Furthermore, little had been known about current handling practices for cats in veterinary clinics. Thus, the current thesis aimed to build knowledge in this area, by: 1) exploring how cats are being handled in veterinary clinics, and describe factors that influence use of various restraint methods (Chapter 2); 2) validating methodologies that can be used to assess cat responses to restraint (Chapters 3 and 4); and 3) examining cat responses to two contentious restraint methods, scruffing and clips (Chapter 5).

2. Key Findings

2.1 Common Cat Handling Techniques and Factors Influencing Use

Chapter 2’s questionnaire results show that methods used to handle cats in veterinary clinics throughout Canada and the USA are dependent on cat demeanor (calm, fearful, aggressive) and reason for handling (examination, procedures). Passive and minimal restraint techniques are commonly used to handle calm cats for examination and procedures, and fearful cats for examinations, but are rarely used when handling aggressive cat examinations and procedures. Full-body and scruff restraint methods are
rarely used for calm and fearful cats during examinations, but are commonly used to handle these cats for procedures. Use of loose towels are sometimes used for calm cats and commonly used on fearful cats during examinations and procedures. Burrito towel wraps (head-in), and to a lesser extent, reverse burrito (head-out) wraps, are commonly used on fearful cats for procedures. When handling aggressive cats, full-body restraint and scruffing are commonly used for examinations and procedures, in addition to alternative tools (loose towels, towel wraps, gloves, face masks). In summary, many respondents indicated use of immobilizing restraint techniques on fearful and aggressive cats for examinations and procedures, with decreased use on calm cats, despite use of these types of techniques not being in line with current cat handling guidelines.

This study’s results suggest that many factors influence cat handlers’ use of full-body with scruff restraint for examinations on cats. There was a decreased odds of using this restraint for participants that work in Canada rather than the USA (for fearful cats), at an AAFP Cat-Friendly Practice® in comparison to one that is not (for fearful and aggressive cats), as a veterinarian as opposed to non-veterinarian staff members (for fearful cats), or as a non-veterinarian staff member that completed an appropriate training program and graduated in or before 2005 (fearful and aggressive cats). Moreover, veterinarians were less likely to use minimal restraint during procedures on fearful cats, but more likely to use minimal restraint on aggressive cats for examinations, in comparison to non-veterinarian staff members.

The questionnaire results provided an overview of how cats are being handled in veterinary clinics throughout Canada and the USA, and the factors that influence this handling. However, they do not inform what type of techniques should be used: my next aim. It is important to examine if commonly used techniques are negatively perceived by cats before objective, evidence-based recommendations are made. This will allow scientifically-informed decisions to be made by handlers, with the goal of reducing negative experiences for cats. But first, given a lack of validated methodologies for use in assessing common restraint techniques, Chapter 3 and 4 focused on developing and validating methodologies for use in examining negative cat responses to handling.
2.2 Validating Methodologies to Identify Cat Responses to Handling

It is important to ensure welfare-assessment methods have construct validity, meaning they measure what they are thought to measure (Cronbach and Meehl, 1955; Martin and Bateson, 2007), prior to using them to examine animal responses to a particular stimulus and to differentiate between animals that are or are not exposed to the stimulus. To validate cat responses to negative handling, I used a known negative handling treatment for comparison against a control technique: full-body restraint involving placing cats on their side and immobilizing their head, body, and limbs. Passive restraint was the control restraint; cats were placed in a body position of their choosing (usually standing or sitting in an upright position), and allowed some movement of their head, body, and limbs. This technique involved minimal handling while still allowing an examination to be performed. Response differences between these two restraint techniques were used to validate negative behavioural and physiological responses to handling in cats (Chapter 3 and 4).

Before testing, all cats underwent a friendliness test and were categorized as either friendly or unfriendly based on interactions with a stranger. This test was performed on cats given our hypothesis that individual cats vary in their response to strangers, and that this would affect their responses during handling.

Chapter 3 examined whether two different paradigms that are designed to assess animal aversion could differentiate between cats handled with the known negative and control techniques. Specifically, I assessed the efficacy of a Handler Aversion test and a Conditioned Place Aversion (CPA) test, which both require avoidance learning. Learned avoidance behaviour in animals is a conditioned affective response to a negative stimulus, designed to help protect the animal’s fitness and welfare (Dawkins, 1990; Fraser and Duncan, 1998). The Handler Aversion Test examined cat aversion to a handler that had performed each restraint method and used a walkway apparatus post-handling, while the CPA test used a two-compartment apparatus to examine learned associations between the compartments and restraint (full-body restraint or passive) techniques. The CPA test was successfully validated to assess responses to
handling for laboratory and friendly shelter cats; cats avoided the compartment where full-body restraint occurred, preferring to spend more time in the compartment where passive restraint occurred. However, large sample sizes were necessary to detect differences for friendly shelter cats, and no preference was detected for unfriendly shelter cats. In contrast to the CPA test, the Handler Aversion test, did not detect differences in aversion behaviour between cats restrained with full-body versus passive restraint. Furthermore, many of the cats did not reach criterion for the walkway training, limiting the usefulness of this general approach. Thus, the CPA test has only limited usefulness for assessing handling with particular cat populations, and the Handler Aversion test, as conducted in the current research, is not recommended for assessing cat responses to handling.

Chapter 4 focused on validating behavioural and physiological responses before, during, and after handling with passive or full-body restraint. Cats struggled more and took longer to be placed into full-body versus passive restraint. During restraint, the following parameters were increased in cats undergoing full-body restraint in comparison to passively restrained cats: respiratory rate, lip licking, and side and back ear positions. In addition, unfriendly cats undergoing full-body restraint showed more pupil dilation than unfriendly cats handled with either passive or full-body restraint. The following parameters were not, however, validated during restraint: vocalizations, tail lashing, and heart rate. After the handler released the cat from restraint, passively restrained cats had a greater odds of staying on the examination table in comparison to full-body restrained cats. The following responses were not validated post-restraint: ear position, tail lashing, and whether or not a cat jumped off the table. Response differences detected during and after restraint that were increased in full-body restrained cats, were also seen in lower levels in passively restrained cats, suggesting passive restraint may have been negative, but to a lesser degree than full-body restraint.

In summary, Chapters 3 and 4 provide the first validated methodologies for examining cat responses to handling. Chapter 3 validated a behavioural paradigm for examining post-handling
avoidance behaviour in cats, and Chapter 4 validated specific behaviour and physiological indicators of a negative response when placing cats into restraint, during restraint, and after restraint.

2.3 Examining Cat Responses to Scruffing and Clip Restraint Methods

Chapter 5 examined cat responses to two contentious restraint methods: scruffing and clips. Our questionnaire results show that scruffing is commonly used to handle calm, fearful, and aggressive cats during examinations and procedures. While clips were not identified as a common restraint method, this scruffing tool has garnered more attention in recent years, and functions in a similar way to scruffing. However, clips differ from scruffing in that they result in targeted and consistent pressure in the dorsal neck region, and are thought to produce varying levels of behavioural immobilization through activation of the dorsal immobility reflex (Pozza et al., 2008). Two studies have examined these restraint methods in cats and suggest that they are effective without eliciting significant stress (Nuti et al., 2016; Pozza et al., 2008). However, these studies did not use validated response measures, did not assess post-handling avoidance behaviour, and did not use a control or known-negative treatment for comparison of responses between handling methods.

Chapter 5 examined scruffing and clips in shelter cats, with passive (control) and full-body (known negative) restraint for comparison, using the validated methodologies from Chapter 4 (validated response parameters: respiratory rate, pupil dilation, lip licking, and side and back ear positions). My results show that full-body restrained cats showed the greatest number of negative responses in comparison to passive (respiratory rate, pupil dilation, side and back ear positions, vocalizations) restrained cats. Full-body restrained cats also showed more negative responses in comparison to scruff restraint (pupil dilation, vocalizations); no differences in responses were detected in comparison to clip restrained cats. Clip restrained cats showed more negative responses than scruff restrained cats (pupil dilation and vocalizations), and passively restrained cats (pupil dilation, vocalizations, side and back ear positions), while scruff restrained cats showed more negative responses than passively restrained cats (pupil dilation, vocalizations). These results indicate that clip restraint is comparable to full-body restraint.
in terms of cat responses, and is more negative than scruffing. Moreover, scruff restraint is less negative than clip and full-body restraint, but more negative than the control, passive restraint. Based on our results, scruff appears to be preferable to clip restraint, but passive restraint is preferable to both restraint methods. Further research is needed to examine whether alternatives, such as towels, muzzles, and chemical restraint, are effective and provide animal welfare improvements.

3. Limitations

There were some general limitations to the research included in this thesis. In Chapter 2, the questionnaire only reached a limited sample of veterinarians and veterinary staff members throughout Canada and the USA, and there may have been a sampling bias towards those with a special interest in cat handling. In addition, the majority of participants were female, and a greater number of responses were received from non-veterinarian staff members than veterinarians. Although just over half of veterinarians in the USA and Canada are female (American Veterinary Medical Association, 2015; Canadian Veterinary Medical Association, 2017), a larger portion of non-veterinarian staff members are female (Loftsedt, 2003). In addition, the survey was distributed through email and social media accounts, limiting responses to those with active accounts. These factors may have biased the responses received in regard to handling methods used, with a bias towards the use of guidelines recommending handling techniques. However, even with this potential bias, we found that a large number of respondents were using techniques involving a high level of immobilization.

The response differences (validated cat behavioural and physiological results) between passive and full-body restrained cats were comparable between Chapter 4 and Chapter 5. However, the Chapter 5 results did not show differences in lip licking between passive (control treatment) and full-body (negative treatment) restrained cats. Instead a greater number of vocalizations were recorded in full-body versus passive-restrained cats, and response direction was consistent with other indicators across treatment groups. Overall, these differences indicate that in response to handling, the shelter cats used in the
clip/scruff study (Chapter 5) were more vocal and lip licked less than the shelter cats used in the validation study (Chapter 4). This suggests that these two measures (vocalizations and lip licking) are less reliable than the other measures that were consistent between studies. Different animal shelter locations and cats were used for these two studies, with many differences in facility design, management, and cage type, leading to differences in exposure to stimuli such as loud noises or other species. Results showing strong external validity across populations were: pupil dilation, lip licking, and respiratory rate, and may be particularly useful when examining negative responses to handling with the treatments used in this thesis (full-body, passive, clip, scruff), across different pet cat populations.

Shelter cats used in this thesis were limited to cats that did not show overly aggressive behaviour during handling, for the safety of the researchers and the cats. Thus, the results and conclusions drawn from the current cat handling studies may not be valid for use on aggressive cats. However, given that only a few cats per study showed overly aggressive behaviour (Chapter 3: Handler Aversion Test- four cats, CPA shelter cat testing- two cats; Chapter 4: four cats; Chapter 5: two cats), the results may be applied to most companion cats.

The CPA preference test (Chapter 3) was validated for use in laboratory, and friendly shelter cats. However, for use in shelter cats, the CPA was not sensitive enough to detect differences in all cats, with a large sample size of friendly cats required. This limits practicality of use in shelter cats. This test was sensitive with laboratory cats, requiring a small sample of cats regardless of friendliness. Thus, further research replicating and expanding use in laboratory cat populations is recommended.

4. Practical Applications

The research included in this thesis has many practical applications that will help improve cat health and welfare during handling and restraint. The questionnaire (Chapter 2) results show where further efforts are needed so that cat handling practices are in line with current cat handling guidelines (Anseeuw et al., 2006; Carney et al., 2012; Hammerle et al., 2015; Herron and Shreyer, 2014; Lloyd, 2015; Sanderson et al., 2016).
2017; Rodan et al., 2011; Rodan, 2010; Yin, 2009), and the AAFP Cat-Friendly Practice® initiative. In addition, the results identified multiple factors that influence use of various cat handling differences: country (Canada versus USA), position (veterinarians versus non-veterinarian staff members), and year of graduation (veterinarians versus non-veterinarian staff members) / education completed (non-veterinarian staff members). It is important to work towards widespread use of handling techniques that reduce negative responses, and reduce use of full-body restraint and scruffing techniques which increase negative responses in cats. The questionnaire results may be used as a baseline to examine future progress made with new cat-friendly initiatives (examples: Dr. Sophia Yin’s Low Stress Handling® University, and the Fear-Free™ program). In addition, the results suggest veterinarians may serve as role models for handling, implementing low-stress handling techniques in veterinary clinics, shelters and laboratory facilities. Veterinarians may also serve as role models to teach cat owners how to habituate cats and kittens to handling of various body parts (E.g., paws). However further research is needed to assess types of kitten handling that may help reduce negative responses during future veterinary examinations.

The validated negative cat responses to restraint (pupil dilation, lip licking, respiratory rate, and side and back ear positions; Chapter 4), and vocalizations (full-body versus passive restraint, Chapter 5) are very useful for cat handlers in veterinary, shelter, and laboratory environments. These indicators can be useful to identify negative responses during handling, which could allow for an individualized approach in which handling is adjusted to reduce the number of negative cat responses seen. However, these measures should be used with caution as further research is needed to assess sensitivity (if small deviations in the true value of the response are mirrored by the measured response; Martin and Bateson, 2007) and specificity (method used to measure response only measures this particular response; Martin and Bateson, 2007) if these measures are to be used with individual cats; the validation that was performed relates to detection of differences between groups.

Assessment of cat responses to scruffing and clips (Chapter 5) suggests that these methods are negative in comparison to passive restraint, and that clips may be more negative than scruffing.
Considering no significant response differences were detected between cats handled with full-body and clip restraint, these restraint methods are comparable and thus it is recommended to avoid the use of clips. Scruffing restraint was more negative than passive restraint, but resulted in less negative responses than clip restraint. Therefore, we recommend the use of scruffing over clips, but advise that both techniques should be avoided when possible. Overall, we recommend use of handling techniques that minimize negative responses in cats during handling.

5. Future work

About half of cat owners in Canada and the USA do not bring their cats to the veterinarian for routine health examinations each year (Volk et al., 2011; Carvelli et al., 2017), with cat owners reporting stressful experiences at the veterinary clinic (Volk et al., 2014). It is not only important to improve the clinic experience for the cat, but also for the cat owner. One potential improvement is to identify owner attitudes towards various handling techniques, to identify the ones that cat owners prefer, and those which owners disagree with. If handling techniques are used on cats which reduce negative responses, and owners agree with use on their cat, this may help increase client satisfaction at the veterinary clinic, improving the veterinarian-client relationship, as well the client’s experience. By doing so this may increase owner willingness to bring their cat back for routine examinations, necessary to maintain a cat’s health and welfare.

A number of cat-friendly initiatives (E.g., American Association of Feline Practitioners (AAFP) Cat Friendly Practice® program, Dr. Sophia Yin’s Low Stress Handling® University, Fear-Free™ program) have been introduced since the questionnaire (Chapter 2) was administered in 2015. It would be beneficial to repeat the questionnaire as human behavioural changes take time, to examine progress of these initiatives, as well as to continue to assess areas where improvements are needed. Given that there is a lack of science-based recommendations provided by current guidelines and initiatives, it is also important to use science-based evidence to improve recommendations, ensuring enhancement of cat
welfare. For example, the validated methodologies (Chapter 4) were used to examine cat responses to scruffing and clips (Chapter 5), but many other cat handling techniques are commonly used (example: loose towel, head-in/head-out towel wraps, gloves and cat muzzles; Chapter 2) and are recommended for use (example: loose towel, head-in/head-out towel wraps) by various guidelines. The validated response measures (Chapter 4) were successfully used to assess cat responses to clip and scruff restraint (Chapter 4 versus Chapter 5), and should be used to examine cat responses to these restraint techniques. Given that the CPA test (Chapter 3) could not be consistently repeated using shelter cats, further research is needed to refine the procedure, or to develop a different behavioural paradigm to examine cat aversion behaviour post-handling.

Cats are exposed to a variety of stimuli during veterinary visits that may have a negative effect on welfare, and that have yet to be examined. Future work should therefore examine other potential stressors, such as common background noise, unfamiliar smells, and exposure to unfamiliar animals. For example, previous research in cattle (Waynert et al., 1999) and dogs (Hydbring-Sandberg et al., 2004) have demonstrated that this species shows an increase in heart rate in response to noise during handling. It would also be interesting to examine how cats respond to different environments and distractions, such as performing procedures in the examination room versus moving the cat to a treatment area, using cat-only examination rooms versus those that dogs have been in, and using treats, catnip and toys for distraction and formation of positive associations, and having owners be present versus not present during handling for examinations and procedures; currently no research has assessed these factors for reducing negative responses during handling in cats.

Handler effects also need to be assessed in future work. In the current thesis, I was the cat handler throughout each study and consistently wore a white lab coat. It would be interesting to assess cat responses during handling to handlers of different sex (male versus female), different lab coat color (E.g., white versus blue versus green), and number of personnel and handling staff present during handling (one handler versus two handlers versus three handlers), to examine if any of these factors lead to a reduction
in negative responses during handling. One study in shelter dogs suggests that petting by female handlers resulted in dogs spending more time in a relaxed, head-up posture, than when stroked by male handlers (Hennessy et al., 1998), suggesting handler sex may influence animal responses. Although little research has assessed the influence of other factors during animal handling, past studies have shown that use of different coat colours (e.g., white versus blue) helps animals distinguish between handlers and handling treatments (dairy calves: Rybarczyk et al. 2003; dairy cows: Munksgaard et al., 1997; pigs: Koba and Tania, 1999). This suggests an animal’s past handling experiences by handling personnel wearing a specific colour coat (e.g., white coats worn by veterinarians), may influence responses during future handling. Further research is needed to elucidate the effect that various handler and other factors, has on cats during handling in a veterinary clinic setting, animal shelter setting, and laboratory setting.

The research in this thesis was the first to examine how cats are routinely handled and restrained in veterinary clinics, and the first to develop and validate methodologies to examine cat welfare during restraint. The validated negative responses to restraint can be practically applied by handlers in various settings (animal shelters, research laboratories, and veterinary clinics), for use in reducing negative responses. In addition, through application of these methodologies, I determined that clip restraint in shelter cats’ results in negative responses that are comparable to cats undergoing full-body restraint, and that scruff restraint is less negative than clip restraint, but more negative than passive restraint. Overall, this thesis is an important first step towards providing evidence-based recommendations to improve cat welfare during handling. The methodologies that have been developed can be used in future research to examine alternative handling techniques, such as loose towels and towel wraps, and to examine the efficacy of other strategies for improving cat welfare during veterinary visits.
References


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Yin S. Low stress handling, restraint and behavior modification of dogs and cats. Cattle Dog Publishing. California, USA.
Appendix A Cat Handling Questionnaire

Handling in the Veterinary Clinic - Consent Form

You are asked to participate in a research questionnaire conducted by Dr. Lee Niel and Carly Moody (PhD student) from the Department of Population Medicine at the Ontario Veterinary College, University of Guelph.

If you have any questions or concerns about this research, please feel free to contact: Dr. Lee Niel at 519-824-4120 x53030 lee.niel@uoguelph.ca, or Carly Moody at cmoody@uoguelph.ca

PURPOSE OF THE STUDY
This study aims to identify feline handling techniques that are commonly used during routine examinations and procedures within veterinary clinics in Canada and the United States (US) The results of the questionnaire will be used to inform future studies assessing handling techniques that minimize stress in cats

BENEFIT TO PARTICIPANT
This research is one part of a series of studies with the overall aim to provide evidence-based recommendations for reducing stress in cats in relation to handling in veterinary settings. Although there is no direct benefit for the individual participant, the overall profession will benefit, as this research will lead to reduced feline handling stress and thus improved veterinary care, as well as increased client willingness to seek appropriate veterinary care

PARTICIPATION AND WITHDRAWAL
Participation is completely voluntary. Participants must be 18 years or older and currently working in a veterinary clinic within Canada or the US, as one of the following: Veterinarian, registered or non-registered veterinary technician / technologist, veterinary assistant or other clinic staff that take part in feline handling during routine examinations and/or procedures. The questionnaire consists of 4 parts and 24 questions total. Anticipated time commitment is about 15 minutes. You may discontinue participation in the study at any time without consequence. However once your responses are submitted, we are unable to remove them since they are not associated with your identity. Contact Lee Niel or Carly Moody (see contact information above) if you have concerns or questions regarding participation or withdrawal from the survey

CONFIDENTIALITY
All information received will be kept confidential. Data will be kept for 10 years after which will then be destroyed. Please note that confidentiality cannot be guaranteed while data are in transit over the internet. You can help ensure your privacy by taking the following precautions to clear all private data from the computer you are using to respond to the survey: Clear the browsing history Clear the cache Clear the cookies Clear the authenticated session LOG OFF
If you are using Internet Explorer, the first 4 steps can be accomplished by going to Tools and selecting Delete Browser History.

This study poses no known physical or psychological risks to participants. Participants may choose to provide an email address to request a copy of the published work. Email addresses will be kept separate from the questionnaire data and will be kept confidential on a password protected computer server within a locked room.

RIGHTS OF RESEARCH PARTICIPANTS
You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, please contact:

Director, Research Ethics, University of Guelph
Telephone: (519) 824-4120, ext. 56606
E-mail: sauld@uoguelph.ca

Please save or print this page now if you would like a copy for your records.

*Note: Your responses will automatically be saved as you go, and you may go back and change a response at any time before submission.

If you have read the above information and agree to participate in this study, please select the "yes" button below to proceed to the questionnaire.

- Yes
- No

Part 1: Demographic Information (7 Questions)

1. Are you a:
   - Practicing Veterinarian
   - Veterinary Technician/Technologist (registered or non-registered)
   - Veterinary Assistant
   - If other, please type in the text box below:
2a. Did you attend school for your position:

- Yes
- No

2b. What school did you attend?
If you prefer not to answer, please leave the box blank

________________________________________________________________

2c. What year did you graduate from your program?

- 2006 - 2015
- 1996 - 2005
- 1986 - 1995
- 1976 - 1985
- 1965 - 1975
- < 1965

3. Are you:

- Male
- Female
- Other
- Prefer not to answer

4. Do you examine cats at your clinic?
5. In what province/state is your clinic located? Please use the drop down menu for your selection.

- Yes
- No

- Alabama (1)
- Alaska (2)
- Alberta (3)
- Arizona (4)
- Arkansas (5)
- British Columbia (6)
- California (7)
- Colorado (8)
- Connecticut (9)
- Delaware (10)
- District Of Columbia (DC) (11)
- Florida (12)
- Georgia (13)
- Hawaii (14)
- Idaho (15)
- Illinois (16)
- Indiana (17)
- Iowa (18)
- Kansas (19)
- Kentucky (20)
- Louisiana (21)
- Maine (22)
- Manitoba (23)
- Maryland (24)
- Massachusetts (25)
- Michigan (26)
- Minnesota (27)
- Mississippi (28)
- Missouri (29)
- Montana (30)
- Nebraska (31)
- Nevada (32)
- New Brunswick (33)
- New Hampshire (34)
- New Jersey (35)
- New Mexico (36)
- New York (37)
- Newfoundland (38)
6. Please provide the name of your current clinic(s):
(If you prefer not to answer, please leave the box blank) *This question is to account for multiple staff members from the same clinic completing the survey

____________________________________________________

7. Is your clinic an American Association of Feline Practitioners certified Cat Friendly Practice?

○ Yes

○ No

8. How did you hear about this survey?

○ Social media site (Ex. Facebook)

○ Email
  If possible, please indicate the organization you received the email from:
  __________________________________________________________

○ If other, please state:
  __________________________________________________________

II Part 2: General Handling Information (9 Questions)
1. Does your clinic have a separate/dedicated exam room(s) for cats only?
   - Yes
   - No

2. At your clinic, how often does a non-veterinarian perform a pre-exam for each cat?
   - Always
   - Often
   - Sometimes
   - Rarely
   - Never

3. How often do you handle cats at your clinic?
   - Daily
   - Weekly
   - Monthly
   - Never

4. What is the average number of cats you handle per day?
5. How often do you offer treats during the process of handling?

- Always
- Often
- Sometimes
- Rarely
- Never

6a. Does your clinic have a standard protocol for approaching and handling aggressive cats?

- Yes
- No

6b. Overall, do you think this standard protocol is followed by clinic staff?

- Yes
- No

9. How often do you provide information to your clients about ways to reduce stress for future visits?
7. How often do you use chemical restraint (e.g. sedative, anaesthesia) when handling a:

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<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
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<td>Fearful Cat</td>
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<td>Aggressive Cat</td>
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8. When you have difficulty handling a cat, how often do you record relevant details in their record?

- Always
- Often
- Sometimes
- Rarely
- Never

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**Part 3: Handling Techniques** (6 Questions)

For the next set of questions you will be asked to indicate how often you use various cat handling techniques for the following: 1) routine examination, and 2) routine procedures, on cats that are either calm, fearful or aggressive. Definitions will be provided.
The 6 questions will be set up in the following way:

1) When handling a CALM cat for routine EXAMINATION, how often do you use the following handling techniques:

2) When handling a FEARFUL cat for routine EXAMINATION, how often do you use the following handling techniques:

3) When handling an AGGRESSIVE cat for routine EXAMINATION, how often do you use the following handling techniques:

4) When handling a CALM cat for routine PROCEDURES, how often do you use the following handling techniques:

5) When handling a FEARFUL cat for routine PROCEDURES, how often do you use the following handling techniques:

6) When handling an AGGRESSIVE cat for routine PROCEDURES, how often do you use the following handling techniques:
1. When handling a **CALM** cat for routine **EXAMINATION**, how often do you use the following handling techniques:

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<th>Sometimes</th>
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<tr>
<td><strong>Secure Restraint</strong></td>
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<td>The cat's head and body is wrapped in a towel, with an opening at the back end to allow examination of the chest down</td>
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**Towel Roll**
A towel is rolled up length-wise, with the centre of the roll placed under the cat's chin, across the chest. The roll is folded back, along both sides of the body.

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<th>Face Mask</th>
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<tr>
<td>Cat Bag</td>
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<td>Scruffing Tool</td>
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  (e.g. clip) |
| Gloves   |
| Elizabethan Collar |
  (e-collar) |
2. When handling a **FEARFUL** cat for routine **EXAMINATION**, how often do you use the following handling techniques:

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**Cat Bag**

**Scruffing Tool**
*(e.g. clip)*

**Gloves**

**Elizabethan Collar**
*(e-collars)*
3. When handling an AGGRESSIVE cat for routine EXAMINATION, how often do you use the following handling techniques:

<table>
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<tr>
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<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>Secure Restraint + Head Hold</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cat's head is held under the jaw and on top of the head, while the cat is held securely by the handler, immobilizing the body and legs, allowing the cat little to no movement</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>Loose Towel</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A towel is loosely draped over the cat's body and/or head</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>Burrito Style Towel Wrap</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cat's head and body is wrapped in a towel, with an opening at the back end to allow examination of the chest down</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>Reverse Burrito / Style Scarf Towel Wrap</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cat's full body, excluding the head, is wrapped in a towel. There may be an opening at the back end to allow examination of the abdomen down</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>Towel Roll</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A towel is rolled up length-wise, with the centre of</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

193
the roll placed under the cat's chin, across the chest. The roll is folded back, along both sides of the body.

<table>
<thead>
<tr>
<th>Face Mask</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat Bag</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scruffing Tool</td>
<td>(e.g. clip)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elizabethan Collar</td>
<td>(e-collars)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. When handling an AGGRESSIVE cat for routine PROCEDURES, how often do you use the following handling techniques:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Restraint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal Restraint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Restraint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal Restraint + Scruff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Restraint + Scruff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Restraint + Head Hold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loose Towel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burrito Style Towel Wrap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Burrito / Style Scarf Towel Wrap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towel Roll</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The roll is folded back, along both sides of the body

<table>
<thead>
<tr>
<th>Item</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Face Mask</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Cat Bag</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Scruffing Tool</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>(e.g. clip)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Elizabethan Collar</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>(e-collars)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**IV Part 4: Exam Room Handling Locations** (1 Question)

1. When handling a **CALM**, **FEARFUL**, or **AGGRESSIVE** cat in an exam room, how often do you handle the cat:

   **i On the exam room floor**

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   **ii. On your lap**

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### iii. In the bottom of the carrier with or without a towel

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Fearful Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### iv. On the exam table

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Fearful Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### v. On the scale used to weigh the cat

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Fearful Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
vi. **Alternative surfaces such as a bench or chair**

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggressive Cat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Comments**

If you would like to add any additional information or comments, please do so in the box below

________________________________________________________________
________________________________________________________________
________________________________________________________________
End
Appendix B Questionnaire Handling Technique Definitions

Descriptions of the 15 different handling techniques that were provided to participants in the questionnaire to examine common handling methods that veterinarians and non-veterinarian staff members use on calm, fearful, and aggressive cats during examinations and procedures.

<table>
<thead>
<tr>
<th>Handling Technique</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive restraint</td>
<td>The cat is handled lightly with the least restraint possible, allowing movement of the body and limbs</td>
</tr>
<tr>
<td>Minimal restraint</td>
<td>The cat is restrained allowing minimal movement of the body and limbs</td>
</tr>
<tr>
<td>Secure restraint</td>
<td>The cat is held securely by the handler, immobilizing the body and legs, allowing the cat little to no movement</td>
</tr>
<tr>
<td>Minimal restraint + scruff</td>
<td>The cat's skin and fur at the back of the neck is grasped using one hand and held in a fist. The cat is restrained allowing minimal movement of the body and limbs</td>
</tr>
<tr>
<td>Secure restraint + scruff</td>
<td>The cat's skin and fur at the back of the neck is grasped using one hand and is held in a fist. Cat is held securely by the handler, immobilizing the body and legs, allowing the cat little to no movement.</td>
</tr>
<tr>
<td>Secure restraint + head hold</td>
<td>The cat's head is held under the jaw and on top of the head, while the cat is held securely by the handler, immobilizing the body and legs, allowing the cat little to no movement</td>
</tr>
<tr>
<td>Loose towel</td>
<td>A towel is loosely draped over the cat's body and/or head</td>
</tr>
<tr>
<td>Burrito style towel wrap</td>
<td>The cat's head and body is wrapped in a towel, with an opening at the back end to allow examination of the chest down</td>
</tr>
<tr>
<td>(referred to as head-in wrap)</td>
<td>Reverse burrito / scarf style towel wrap</td>
</tr>
<tr>
<td>Towel roll</td>
<td>The cat's full body, excluding the head, is wrapped in a towel. There may be an opening at the back end to allow examination of the abdomen down</td>
</tr>
<tr>
<td>Face mask</td>
<td>No description provided</td>
</tr>
<tr>
<td>Cat bag</td>
<td>No description provided</td>
</tr>
<tr>
<td>Scruffing tool</td>
<td>E.g. clip</td>
</tr>
<tr>
<td>Gloves</td>
<td>No description provided</td>
</tr>
<tr>
<td>Elizabethan collar</td>
<td>No description provided</td>
</tr>
</tbody>
</table>
*A picture of each handling technique was provided with the questionnaire, but were not approved for inclusion in publication.