SELINUS UNIVERSITY
OF SCIENCES AND LITERATURE

Heart Rate Variability as a Welfare Indicator Within Professional Dog Grooming: A Clinical Psychology Perspective on Emotional Regulation and Grooming Practice

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A THESIS

Presented to the Department of
Clinical Psychology
program at Selinus University

Faculty of Psychology
in fulfilment of the requirements
for the degree of Doctor of Philosophy
In Clinical Psychology

2026

Declaration

I do hereby attest that I am the sole author of this thesis and that its contents are only the result of the readings and independent research I have done.

It has not been submitted, in whole or in part, for any other academic degree or qualification. All sources of information and data used in this work have been acknowledged appropriately.

Signed:

Dean Hart

Date: 12th January 2026

Table of Contents

Abstract

This thesis investigates grooming-induced stress in companion dogs using a psychophysiological stress-response framework that integrates behavioural observation, heart rate variability analysis, Root Mean Square of Successive Differences (RMSSD), a Canine Autonomic Stress Response Index (CASRI), and a Grooming Stress Index (GSI).

The study was conducted in a professional grooming salon in Seaford, East Sussex, United Kingdom. Findings reveal breed-linked patterns of resilience and vulnerability, with toy breeds demonstrating unexpected physiological stability despite displaying behavioural indicators of distress. Age and trauma history also emerged as significant factors, with senior dogs and those with known adverse experiences showing heightened stress reactivity and reduced recovery capacity.

Passive stress responses, such as immobility and withdrawal are widely recognised as vulnerable to misinterpretation, particularly in fast-paced or task-focused grooming environments. Reflexive notes document ethical adjustments made to handling practices to safeguard canine wellbeing. Rather than offering a formal critique of existing legislation, the thesis uses empirical evidence to highlight gaps in current regulatory frameworks and to support calls for systemic reform. Sensory triggers, restraint devices, and anticipatory cues such as grooming uniforms consistently elicited measurable stress responses.

The research advocates for welfare-led grooming practices and the integration of behaviour-aware education into professional training and everyday practice. It also underscores the value of clear visual aids and owner handouts in supporting and empowering lay participants in understanding the behaviour and welfare needs of pets. Overall, the findings provide empirical support for grooming approaches that prioritise emotional safety and evidence-based welfare practice.

Acknowledgements

I am indebted to Sara Hart LCGI, City & Guilds Grooming Lecturer, external examiner, and Medal for Excellence recipient, whose professional expertise has been instrumental throughout this research. Her immense knowledge of grooming, both in theory and in practical application, has shaped the precision and ethical clarity of this study. Her compassion toward all animals, and her welfare led approach to handling, reflect the highest standards of trauma informed practice. At the time of this research, Sara was actively engaged in grooming and teaching; due to illness, she has since stepped back from both. Her contribution remains deeply valued, and her patience in listening to my evolving ideas, along with her commitment to emotionally safe grooming protocols, exemplify the strength of our professional partnership and our shared dedication to animal welfare.

In addition to her professional contributions, I wish to express my deepest personal gratitude to Sara Hart, my wife, whose unwavering support, patience, and encouragement sustained me throughout this research journey. Her belief in the importance of this work, and in me, especially during my periods of stress and self-doubt made its completion possible.

I am also deeply grateful to the dog owners who generously participated in this study by allowing the use of their dogs for HRV fitting and baseline readings. Their trust, ongoing feedback, patience, and willingness to engage with the research process made this work possible. Their involvement reflects an openness to welfare-led practices and a desire to support more ethical approaches to grooming and behavioural care.

I would also like to extend my appreciation to Professor Salvatore Fava, Coordinator and Supervisor at Selinus University, for his academic oversight during this process. His guidance in shaping the structure and presentation of this work is gratefully acknowledged, as is his commitment to supporting independent scholarship.

Glossary of Terms

This glossary is positioned early in the thesis to support reader understanding of technical, behavioural, and welfare-related terminology. It aims to provide readers with a clear foundation for interpreting the concepts and practices discussed.

Avoidance behaviour - A stress-related response in which a dog actively moves away from a stimulus perceived as threatening or sensory overwhelming. Often seen in grooming contexts as turning away or resisting contact.

Behavioural shutdown / suppression – A passive behavioural state arising from significant emotional overload in which normal behaviour reduces or ceases. Shutdown may present as immobility, withdrawal, refusal of treats, or failure to perform expected sequences (e.g., shake-off after bathing). Unlike dissociation, the dog remains present and processing, but its behavioural repertoire is markedly restricted. Shutdown reflects acute autonomic dysregulation rather than a chronic emotional–cognitive state.

BIOPAC systems - A physiological monitoring system used to record autonomic and psychophysiological responses, including heart rate variability. Commonly used in both human and animal research for continuous, high-precision bio signal measurement.

Blaster - A high-velocity grooming dryer used to remove loose hair and water. Although effective, these can be a significant auditory and tactile stressor for dogs, and a health and safety concern for groomers.

Breed predisposition - Genetic or morphological traits that influence a dog's behavioural and physiological response to stress. For example, brachycephalic breeds may be more vulnerable to overheating and terriers may try to attack the hair dryer.

Canine Autonomic Stress Response Index (CASRI) - A composite scoring system developed in this research to assess autonomic and behavioural indicators of stress in dogs, particularly in grooming contexts.

Circadian Rhythm — The natural, internal biological cycle that regulates physiological and behavioural processes over a roughly 24-hour period, influenced by environmental cues such as light and temperature.

Classical Conditioning (CC) and Conditioned Response (CR) - A CC is a learning process where a neutral stimulus becomes associated with a meaningful one, (both positive or negative values). During grooming, dogs may associate equipment or uniforms with an unpleasant experience. This learning is contextual. A conditioned response (CR) may be developed, even with one single strong presentation of the stimulus, and the behaviour persists in response to the presentation of the CC, without the negative experience even being presented. The conditioned response can also be a conditioned emotional response. For example the grooming uniform tells the dog what is coming next and the dogs learned conditioning response is triggered.

De-matting - The process of removing tangled or matted coat. Can be uncomfortable or painful, especially if carried out inappropriately and a common trigger for defensive aggression or shutdown.

De-shedding – The removal of loose undercoat hair, typically using specialised equipment. Can be stressful depending on the technique applied, equipment and dog's sensitivity.

Defensive aggression - Aggressive behaviour triggered in response to a perceived threat often as a last resort when escape is not possible and or canine communication is ineffective in reducing the stimulus proximity or intensity. This can result from emotional overload and may turn into a conditioned response; temperament isn't the sole factor. Aggression can include growling, lip lifting, snapping or intentional (responsive) bite.

Dissociation in dogs - A psychophysiological state characterised by reduced environmental engagement and a partial disconnection between sensory input and emotional processing. Dogs may appear "glazed," distant, or unresponsive, with blunted startle responses and minimal orienting. Dissociation is deeper than behavioural shutdown and often associated with extreme or repeated stress, reflecting a disruption in awareness rather than simple behavioural inhibition. Interpretation must remain species-specific and avoid anthropomorphic assumptions.

Emotional dysregulation - Difficulty in modulating emotional responses. In dogs, this may present as rapid shifts between avoidance, aggression and hyperarousal.

Ethical grooming practice - Grooming approaches that prioritise canine wellbeing, emotional safety, and consent-based handling. Often includes trauma-informed techniques and sensory awareness.

Grooming Stress Inventory (GSI) - A structured assessment for assessing stress triggers and behavioural responses during grooming. Complements CASRI by capturing practitioner observations.
during grooming.

Groomers Helper© - A restraint device used to restrict dog movement during grooming. May reduce risk of injury but can exacerbate stress if used without emotional literacy.

Hair matting - The tangling and compacting of fur, which can cause skin irritation and pain. Often requires de-matting, (or a full clip off) which may be distressing for the dog (or the owner).

Habituation – Where an animal learns to ignore a non-living stimulus that has no value. Neither appetitive nor aversive. Habituation is contextually leaned.

Heatmap — a visual representation of relationships between variables using colour intensity to show the strength and direction of correlation, often used to display Pearson correlation coefficients

Homeostasis - The physiological balance maintained by the body. Disrupted during stress and restored through parasympathetic activation. Referred to mainly as a physical balance but is also referred to as emotional homeostasis.

Heart Rate Variability (HRV) - A measure of variation between heartbeats, used to assess autonomic nervous system function. Lower HRV often indicates stress or poor emotional regulation.

Hypothalamic–pituitary–adrenal (HPA) axis - A neuroendocrine system that regulates stress responses. Activation leads to cortisol release and physiological changes, present both humans and dogs.

Kindchenschema - A set of infantile features (e.g. large eyes, round face) that elicit caregiving (parental) responses. Relevant in dog breeds selectively bred for neotenic traits. Interpretation must avoid anthropomorphic bias.

Learned helplessness - A chronic emotional–cognitive state that develops when a dog repeatedly attempts, and fails, to influence or escape an aversive situation. Over time, the dog stops trying, showing passive behaviour not because of immediate overload but because it has learned that its actions have no effect. This state has behavioural expressions (e.g., passivity, lack of initiative) and physiological correlates (e.g., reduced HRV) and may generalise across contexts. It differs from behavioural shutdown, which reflects acute autonomic overload without prior coping attempts.

Neotenic (Neoteny) – The retention of juvenile physical or behavioural traits into adulthood. In dogs, neoteny may be expressed through morphological features such as large eyes, rounded skulls, or shortened muzzles, as well as behavioural tendencies associated with juvenile sociality. These traits can influence human perception, caregiving responses, and handling expectations, sometimes masking underlying stress or discomfort.

Parasympathetic - The branch of the autonomic nervous system responsible for rest, recovery, and calming. Activation is associated with emotional regulation and safety.

Passive stress - A stress response in which a dog becomes behaviourally inhibited due to acute overwhelm. The dog remains aware of the environment and may show subtle orienting responses (e.g., eye movements, small flinches, tension shifts), but does not engage in active coping behaviours. Passive stress reflects immediate autonomic overload, not a learned expectation, and is typically context-specific

Positive Arousal - Heightened physiological activation linked to excitement or pleasure. In dogs, this may include play behaviours or tail wagging. Must be distinguished from stress arousal.

Positive punishment – The application of an aversive stimulus immediately following a behaviour with the intention of reducing that behaviour. In canine contexts, this may include actions such as leash jerks, verbal intimidation, physical corrections, or the use of equipment designed to startle or cause discomfort. These methods can increase fear, stress, and behavioural suppression, and may contribute to long-term emotional vulnerability or trauma.

Post-Traumatic Stress Disorder (PTSD) - A psychiatric condition in humans involving re-experiencing, avoidance, and hyperarousal. In dogs, trauma-related behaviours may resemble PTSD but require species-specific interpretation.

Psychophysiological - Refers to the interaction between psychological processes and physiological responses. In canine research, includes HRV, cortisol, and behavioural indicators for example.

RMSSD - Root Mean Square of Successive Differences, an HRV metric reflecting parasympathetic activity. Lower values suggest reduced emotional regulation.

Slicker Brush - A grooming type of brush, with fine, bent wires used to remove tangles and loose hair. Can be uncomfortable and cause abrasions if used with excessive pressure or on sensitive areas.

Socialisation - The process by which dogs learn to interact appropriately with other living beings, both intra and inter species. There are sensitive socialising periods within canine development. Poor or inappropriate socialisation can increase stress reactivity.

Sympathetic (Activation) - The branch of the autonomic nervous system responsible for fight, flight or freeze responses. Physiological and behavioural changes occur, such as increased heart rate, dilated pupils and panting, with defensive or fear aggression, and / or shut down

Trauma-informed - An approach that recognises the impact of past trauma on current behaviour and physiology. In canine care, it involves emotionally literate handling and stress mitigation. This plays part in learned behaviour responses.

Welfare-led practice - Professional conduct that prioritises the emotional and physical wellbeing of the dog over aesthetic or procedural goals. Often includes consent-based handling and sensory awareness.

Unconditioned Response (UR) - A natural, automatic reaction to a stimulus that occurs without prior learning or conditioning. For example, salivating when food is seen or smelled.

List of Figures

List of Tables

List of Tables in Annexes

CHAPTER ONE - INTRODUCTION

1.1 Background of the Study

Emotional regulation and autonomic function are central to Clinical Psychology, particularly in trauma-related contexts and caregiving environments (Siegel, 2020). As companion animals become increasingly embedded in human lives, there is a growing need to understand their emotional responses to routine interventions such as commercial grooming. According to Flannigan & Dodman, (2001), high-sensory environments, physical restraint, and unfamiliar social interactions may trigger distress in dogs, especially those with prior trauma or breed-specific sensitivities. This study draws upon clinical psychophysiological frameworks and sustained professional animal behaviour and grooming experience, where repeated observation of canine behavioural suppression, including passivity, lack of response, and immobility, suggested emotional shutdown patterns.

Research into heart rate variability (HRV) as a non-invasive indicator of stress response in animals (von Borell et al., 2007) and literature on learned helplessness (Maier & Seligman, 2016) support an interdisciplinary investigation of canine distress from a Clinical Psychology perspective. Stress responses in dogs typically fall into two categories: active expression (e.g., growling, snapping, biting) and behavioural suppression (e.g., freezing, failure to engage, poor sequence of expected behaviour and disassociation).

Groomers often misinterpret the latter as compliance or relaxation, when it may represent internalised distress and autonomic dysregulation (Beerda et al., 1997). Differentiating these responses is crucial for recognising hidden welfare risks and promoting emotionally literate care.

Statement of the Problem

Building on the clinical observations outlined above, this section clarifies the problem by examining the autonomic impact of misinterpreted distress in grooming contexts. Though routine, commercial grooming may subject dogs to recurring emotional stressors, such as restraint, painful procedures, sensory overload, and overlooked distress, that can accumulate over time. Chronic exposure to uncontrollable stress is linked to sustained autonomic dysregulation, marked by reduced vagal tone and heightened sympathetic activity. These patterns are well-documented in humans (Porges, 2001) and increasingly recognised across species.

1.2.1 Autonomic Consequences of Chronic Uncontrollable Stress

To deepen this understanding, the following section outlines the specific autonomic consequences of chronic, uncontrollable stress in companion dogs. Persistent exposure to uncontrollable stress that can disrupt autonomic regulation and sustain imbalance may significantly affect the emotional and physiological wellbeing of companion dogs, particularly in caregiving contexts such as grooming, where stressors may be repeated or unavoidable. This is especially relevant for designer crossbreeds such as Cockapoos, e.g., (an F1 Cocker Spaniel × Poodle cross), Cavapoos (usually an F1 cross between a Cavalier King Charles Spaniel and a Poodle) and Labradoodles, (usually an F1 cross between a Labrador Retriever and a Poodle) whose popularity in the UK has surged, from 18.8% of new puppies in 2019 to 26.1% in 2020, according to Royal Veterinary College data. These breeds typically require professional grooming every 6 to 8 weeks to prevent matting and discomfort, this increases their exposure to potentially distressing procedures across their entire lifespan.

Zupan et al., (2016) research on heart rate variability suggests that such dysregulation may not only hinder emotional recovery but also contribute to long-term physical harm, including chronic inflammation, immune vulnerability, and behavioural disorders.

Without trauma-informed care, grooming practices risk reinforcing distress in emotionally sensitive dogs and masking harm beneath misread behavioural compliance. Emotional arousal in dogs can manifest physiologically across a spectrum of contexts, from excitement before a walk to distress during grooming, yet elevated heart rate alone cannot differentiate between positive and negative affective states.

This research aims to identify markers of emotional distress specifically, rather than generalised arousal, by pairing HRV metrics with behavioural indicators of suppression and trauma responses. Control readings during positive arousal (e.g., anticipation of a walk) provide a comparative baseline, ensuring that physiological changes observed during grooming are interpreted accurately within a Clinical Psychology framework.

1.3 Research Objective/Aim

To investigate emotional suppression and autonomic regulation in companion dogs during grooming procedures, using HRV and behavioural observations informed by Clinical Psychology.

1.3.1 Specific Objectives

- To analyse HRV changes across seven grooming phases (arrival, restraint, nail trim, bathing, drying, clipper work, scissor trimming).
- To identify behavioural markers of learned helplessness and emotional suppression.
- To assess the impact of trauma history, age, and breed on heart rate variability (HRV) and autonomic stress responses, with exploratory consideration of treatment type (e.g., de-matting, de-shedding) as a contextual variable.
- While sex and reproductive status (e.g., spayed/neutered) are not central to this analysis, existing research suggests they may influence stress reactivity and are noted as potential covariates.
- To explore how sensory input, equipment, and groomer interactions may influence stress reactivity during grooming, focusing on observable patterns and contextual relevance.

These observations are quantified using the Grooming Stress Index (GSI), a scoring framework developed to integrate HRV data with behavioural markers of distress. This study also seeks to critically evaluate the use of restraint devices in professional grooming settings, such as the Groomers Helper® and grooming slings, which are often applied to dogs deemed “fidgety”, non-compliant, or aggressive regardless of motivational state. While these tools are designed to assist groomers in completing tasks efficiently, their use may inadvertently contribute to canine distress, particularly in the absence of behavioural awareness or emotional-regulation strategies.

1.3.2 Hypotheses

To guide the analysis, the following hypotheses were proposed:

Null Hypothesis (H_0): Grooming procedures do not significantly affect autonomic regulation or behavioural stress markers in dogs, regardless of trauma history, breed type, or age.

Alternative Hypothesis (H_1): Grooming procedures elicit significant autonomic and behavioural stress responses in dogs, with elevated risk in individuals with prior trauma, brachycephalic breeds, and older age groups.

These hypotheses informed the selection of HRV metrics (RMSSD), behavioural coding protocols, and the development of the Grooming Stress Index (GSI).

1.4 Research Questions

- What HRV patterns reflect emotional dysregulation during professional grooming?
- How do behaviours associated with emotional suppression differ from relaxed presentation?
- Which individual factors (breed, age, trauma) predict heightened physiological stress?
- Can Clinical Psychology methods improve welfare literacy and behavioural interpretation in the grooming sector?

1.5 Significance of the Study

This research positions canine grooming within Clinical Psychology, drawing attention to emotional suppression as a welfare concern. It uses HRV as a cross-species biomarker to evaluate autonomic stress responses and applies trauma-informed frameworks to behavioural misinterpretation. The study’s foundation in lived professional experience, supported by expert insights from an award-winning grooming educator, grounds its relevance and ethics. Findings aim to inform grooming education and promote emotionally literate care.

1.6 Scope of the Study

This research focuses on non-clinical, non-sedated grooming procedures conducted in a commercial salon setting, involving dogs aged one year and older, representing a diverse range of breeds and temperaments.

It incorporates HRV data (via a Polar H10 monitor), observational behaviour coding, and trauma-oriented owner questionnaires.

High-impact treatments such as de-matting and de-shedding are acknowledged as potential emotional stressors but are not explored as individual procedural categories. Veterinary interventions, sedation protocols, and rehabilitation grooming are excluded.

1.7 Organisation of the Study

The thesis is organised into seven chapters. Chapter 1 introduces the research aims and context. Chapter 2 reviews relevant literature on heart rate variability, emotional regulation, and canine welfare in grooming. Chapter 3 details the methodology, including data collection and analysis procedures. Chapter 4 presents the results of HRV and behavioural assessments. Chapter 5 discusses the findings in relation to clinical psychology and welfare practice. Chapter 6 concludes with key insights and recommendations. Chapter 7 addresses limitations and suggests directions for future research. Annexes provide supplementary materials and data to support transparency and replicability.

This structure ensures that each chapter contributes directly to the central aim of evaluating heart rate variability as a welfare indicator within professional dog grooming, interpreted through a clinical psychology perspective.

CHAPTER TWO - LITERATURE REVIEW

2.1 Emotional Regulation in Canines

Emotional regulation in dogs refers to their ability to manage and respond to stressors in ways that maintain psychological and physiological balance, a process often described as emotional and physical homeostasis. This capacity is shaped by genetics, early socialisation, environmental interactions, and conditioning. In grooming contexts, homeostasis is frequently disrupted by sensory and procedural stressors, with prior learning, both direct and indirect, influencing individual responses

Research suggests that dogs exhibit measurable physiological responses, such as elevated cortisol levels and changes in heart rate variability (HRV), when exposed to stress-inducing environments. HRV, is a promising non-invasive biomarker for assessing emotional states and welfare in animals. Low HRV is associated with heightened stress and poor emotional regulation, while higher HRV reflects adaptability and resilience (von Borell et al., 2007; Zupan et al., 2016). To aid interpretation of HRV patterns observed in this study, the following table summarises the relationship between HRV levels and emotional-autonomic states in dogs.

Table 1. HRV reflects the balance between sympathetic and parasympathetic activity. Low HRV (Low RMSSD) indicates stress or autonomic imbalance; high HRV (High RMSSD) suggests adaptability and recovery.

HRV Pattern	Interpretation Summary
Low RMSSD	Indicates reduced parasympathetic activity, heightened stress, or limited emotional regulation capacity
High RMSSED	Suggests greater regulatory flexibility, recovery, and adaptive emotional functioning

Despite its relevance, emotional regulation is rarely considered in professional grooming contexts. The emphasis tends to be on task completion rather than behavioural cues, which can lead to misinterpretation of fear-based responses as “fidgety” or “difficult” behaviour. This gap underscores the need for welfare-informed grooming practices that recognise and support canine emotional regulation as also suggested by (Mills et al., 2014).

2.2 Restraint Practices and Welfare Implications

Restraint equipment such as the Groomers Helper® and grooming slings are widely marketed as solutions for managing “difficult” or “fidgety” dogs during grooming procedures. These devices are designed to immobilise the animal, allowing groomers to perform grooming tasks with greater ease and shorter time. In contrast, Mariti et al. (2015) investigated stress indicators in dogs before and after professional grooming sessions. While the study did not isolate specific equipment, it found that dogs exhibited elevated stress behaviours, such as increased nose licking after grooming, suggesting that the environment and handling methods contribute to distress. In addition, Mariti et al. (2015), stated that grooming facilities may be stressful for dogs throughout their stay, and further research is needed to assess the impact of specific equipoment.

However, restraint equipment use raises significant welfare concerns, particularly when applied without consideration of the dog’s emotional state, motivation or behavioural signals. Tight restraint, especially when applied to dogs already exhibiting signs of stress, can exacerbate distress and lead to learned helplessness or behavioural shutdown (Overall, 2013).

The Groomers Helper® system, for example, is endorsed by many grooming professionals for its efficiency and safety claims. Yet, there is limited empirical research evaluating its impact on canine stress responses. The manufacturer promotes it as a tool for “hands-free grooming” and “reducing bites and injuries”, but these claims are largely anecdotal and not supported by peer-reviewed studies (Groomers Helper®, 2025).

Yin (2009) emphasises the importance of low-stress handling and understanding canine body language to avoid escalating fear or defensive aggression. Groomers who rely solely on mechanical restraint may overlook subtle signs of distress, such as lip licking, yawning, or avoidance behaviours, which are critical indicators of emotional dysregulation (Yin, 2009).

This lack of behavioural awareness is compounded by the absence of formal training in emotional regulation and appropriate welfare assessment within the grooming industry. Mills, Karagiannis and Zulch (2014) argue that stress responses in companion animals are often misunderstood or ignored, particularly in non-clinical settings. Their work highlights the need for integrating behavioural science into everyday animal care practices to ensure that welfare is not compromised in pursuit of efficiency, a principle that holds relevance within the dog grooming industry.

Studies in veterinary settings have shown that restraint techniques can significantly impact a dog's stress levels. For example, improper handling or forced positioning can trigger defensive aggression or withdrawal (Yin, 2009). In grooming environments, where restraint is often prolonged and combined with unfamiliar stimuli, the risk of emotional dysregulation is heightened.

Moreover, there is limited training among grooming professionals in low-stress handling or behavioural observation. As McDonald et al. (2022) note, grooming-related distress is an overlooked welfare concern, with many cases involving matting injuries or behavioural deterioration due to inadequate handling practices. The prevailing attitude that "the job has to get done" often overrides the animal's emotional experience, reinforcing a task-centric rather than welfare-centric approach (Mills et al., 2014).

2.3 Foundations of HRV and Justification

Heart rate variability (HRV) is a widely used non-invasive biomarker for assessing autonomic nervous system (ANS) function. It reflects the dynamic interplay between sympathetic and parasympathetic branches, offering insight into emotional regulation, stress reactivity, and physiological resilience. In Clinical Psychology, HRV is employed to assess adaptability, trauma recovery, and autonomic flexibility (Thayer & Lane, 2000). Its application to animal welfare has gained traction, with studies linking reduced HRV to heightened stress and impaired emotional regulation in dogs (von Borell et al., 2007; Zupan et al., 2016). In trauma-informed welfare contexts, HRV provides a valuable lens through which autonomic dysregulation can be observed and quantified, supporting both behavioural interpretation and physiological assessment.

2.3.1 Overview of HRV Metrics

This study focuses on one principal HRV metrics: RMSSD, selected for its relevance to autonomic modulation and its interpretive value in short-term stress analysis.

RMSSD (Root Mean Square of the Successive Differences) is a time-domain measure that reflects beat-to-beat variability, primarily governed by parasympathetic activity. It is sensitive to vagal tone and acetylcholine-mediated modulation at the sinoatrial node (SA node), making it a reliable indicator of emotional regulation capacity.

2.3.2 Neurobiological Basis for Metric Selection

Heart rate variability (HRV) was assessed using the Root Mean Square of Successive Differences (RMSSD), a time-domain measure that reflects short-term fluctuations in inter-beat intervals and is widely recognised as a sensitive indicator of parasympathetic (vagal) activity. RMSSD is particularly well suited to canine research because it reliably captures rapid autonomic shifts during short recording windows and is less influenced by respiratory patterns than frequency-domain indices. Its suitability for evaluating stress and emotional arousal in dogs has been demonstrated in several studies (Scheibe et al., 2015; Zupan et al., 2016).

RMSSD was selected as the sole HRV metric in this study to ensure methodological consistency and to align with established best practice in short-duration canine HRV research. The decision was further supported by validation work demonstrating that the Polar H10, the device used in this study, provides reliable HRV measurements in dogs, including accurate RMSSD extraction during field-based activity (Valença et al., 2024).

RMSSD values were extracted for each grooming phase and interpreted alongside behavioural observations and contextual triggers to evaluate physiological stress responses. No frequency-domain metrics (e.g., LF, HF, LF/HF ratio) or long-term variability measures (e.g., SDNN) were included, as the study design and data collection protocol did not support their reliable calculation.

2.3.3 HRV in Trauma-Exposed Populations

In trauma-exposed dogs, autonomic dysregulation may manifest as sympathetic overactivation and parasympathetic withdrawal, observable both behaviourally and physiologically during grooming procedures. HRV metrics offer a structured, non-invasive means of quantifying these responses, supporting welfare-led interpretations of stress and recovery. By pairing HRV data with behavioural observations, this study aims to distinguish between passive compliance and relaxed engagement—an essential distinction in trauma-informed grooming.

2.4 Behavioural Suppression and Misinterpretation

Behavioural suppression is often misinterpreted as relaxation or compliance in grooming settings. However, such behaviours may reflect internalised distress and autonomic dysregulation (Beerda et al., 1997). Clinical Psychology literature on learned helplessness supports this interpretation (Maier & Seligman, 2016).

2.5 Trauma Responses and Emotional Shutdown

Dogs with trauma histories, (history may also include repeated grooming experiences), may exhibit emotional shutdown during grooming, characterised by passive behaviour, flattened affect, or escape or avoidance patterns prior to learned helplessness and poor behavioural sequencing. These responses mirror dissociative patterns observed in human trauma survivors and are often missed in environments that prioritise physical compliance over emotional wellbeing. Alupo (2017) explored canine post-traumatic stress disorder (PTSD) and found that traumatised dogs often display heightened vigilance, startle responses, and behavioural withdrawal, particularly in environments lacking emotional safety. These findings support the need for trauma-informed grooming practices that recognise behavioural shutdown as a welfare concern.

2.6 Individual Differences (Biological and Developmental Factors)

Pastorino (2016) found that dogs acquired from pet shops were more likely to exhibit owner-directed aggression and stress-related behaviours. Mikkola et al. (2021) demonstrated that breed-specific traits, environmental enrichment, and training style all contribute to aggression risk and behavioural dysregulation.

Serpell, Duffy and Jagoe (2016) further emphasised the role of early experience, noting that critical periods in puppy development significantly influence behavioural outcomes, with inadequate socialisation linked to the development factors of fear and avoidance behaviours in adulthood (Serpell et al., 2016).

Together, these findings highlight that behavioural vulnerability is rarely the result of a single factor; instead, it emerges from the interaction of early experience, genetic predisposition, and environmental conditions. This complexity is directly relevant to grooming contexts, where dogs with compromised developmental histories, inadequate socialisation, or separation-related distress may present with elevated stress responses or reduced coping capacity.

2.7 Communication and Morphotype

Canori et al. (2025) found that mesocephalic dogs Mesocephalic breeds (e.g., Labrador Retriever) those that have a skull shape that is neither shortened nor elongated, sitting between brachycephalic and dolichocephalic breed types, displayed more tongue flicking when interacting with brachycephalic breeds, a behaviour linked to uncertainty and early stress signalling. Morphotype plays a significant role in how dogs communicate, both with other dogs and with humans. Brachycephalic breeds, such as French Bulldogs and Pugs, have compressed facial structures that limit their ability to produce clear visual signals, which can lead to misinterpretations during social interactions (Schatz et al., 2021).

Importantly, human behaviour is also influenced by the appearance and perceived temperament of brachycephalic and paedomorphic dogs. Exaggerated facial features of these breeds often evoke nurturing responses due to ‘Kindchenschema’, which may lead groomers (and owners) to underestimate signs of distress or discomfort (Tsao, 2023). To illustrate the influence of paedomorphic traits on human perception and handling, Figure 1 presents a visual comparison between a juvenile dog and a human infant. This pairing highlight morphological features, such as a rounded cranium, large eyes, and soft facial contours. These traits may unconsciously bias welfare interpretation, particularly in breeds selected for neotenic appearance.

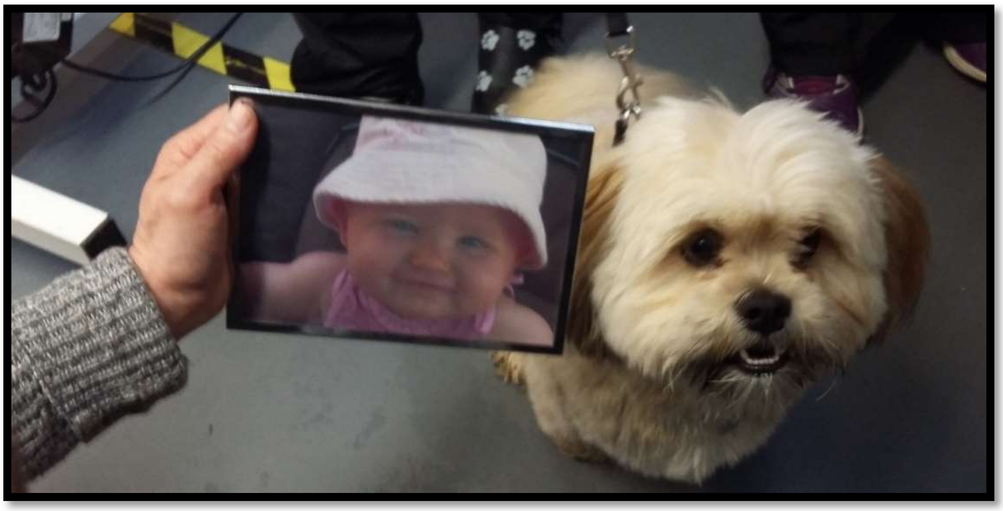

Figure 1. Visual comparison of paedomorphic traits in a juvenile dog and human infant, illustrating features associated with Kindchenschema (baby schema) that are known to influence human perception. Photograph taken by the author in 2001. © Dean Stuart Hart, 2001–2026. All rights reserved.

Therefore, the compressed anatomy of these dogs not only affects their ability to communicate but also shapes the way humans interact with them, sometimes with unintended consequences for welfare and behavioural outcomes.

2.7.1 Thermoregulation, Physical Vulnerabilities, and Learned Pain

Certain dog breeds possess anatomical and medical traits that compromise their ability to regulate stress during grooming procedures. Brachycephalic breeds, such as Pugs, French Bulldogs, and English Bulldogs, are particularly vulnerable due to their shortened skull structure and narrowed airways, which impair panting and thermoregulation. These dogs are at increased risk of overheating and respiratory distress, especially in warm or poorly ventilated grooming environments (Davis et al., 2017).

Furthermore, Ewers Clark (2022) found that brachycephalic dogs are disproportionately represented in clinical cases of heatstroke, with neurological symptoms such as agitation and confusion often preceding collapse.

Beyond thermoregulation, medical conditions such as hip dysplasia, arthritis, and intervertebral disc disease (IVDD) significantly affect a dog's comfort and stress levels during grooming. German Shepherds, Labrador Retrievers, and Dachshunds are particularly prone to these conditions, which can make prolonged standing, lifting, or restraint painful (Cornell University College of Veterinary Medicine, 2025; Vet Help Direct, 2025).

Importantly, dogs with prior injuries may develop learned pain pathways, where repeated exposure to painful stimuli creates a conditioned stress response, even in the absence of current pain. At the neurophysiological level, this involves sensitisation of the central nervous system, particularly within the amygdala and spinal cord, where nociceptive signals are amplified and associated with emotional memory. Over time, this can lead to heightened sympathetic activation and reduced parasympathetic tone, reflected in diminished HRV and behavioural signs of anticipatory distress.

Walsh (2025) explains that pain is not only a physical sensation but also an emotional experience, and dogs may associate grooming environments or specific handling techniques with past trauma. This can lead to anticipatory anxiety, defensive behaviour, or emotional shutdown during grooming sessions. Professor Daniel Mills' et.al. (2020), within their clinical analysis revealed that pain-related behavioural issues are prevalent across age groups, with musculoskeletal pain often underlying aggression, avoidance, or hypervigilance.

These findings underscore the importance of trauma-informed grooming, where prior injury and behavioural history are considered in handling decisions. Groomers must be trained to recognise subtle signs of pain-related stress and adapt their techniques to minimise discomfort and emotional distress.

2.8 Disease and Behaviour Interactions

Repeated exposure to stressful grooming environments can have cumulative effects on canine health, extending beyond behavioural discomfort into physiological illness. Dogs subjected to frequent restraint, unfamiliar handling, loud noises, and unpredictable stimuli may experience chronic activation of the hypothalamic-pituitary-adrenal (HPA) axis, leading to elevated cortisol levels and systemic inflammation (Seksel, 2014). Over time, this stress response can suppress immune function, impair digestion, and increase susceptibility to skin conditions, gastrointestinal upset, and even cardiovascular strain.

A case study published in the Brazilian Journal of Animal Science tracked behavioural and physiological responses in dogs across 55 grooming sessions. Researchers found that stress markers, such as panting, trembling, and avoidance behaviours, were most pronounced during arrival and drying phases. Notably, repeated exposure to these stressors correlated with elevated heart rate and behavioural shutdown, suggesting a pattern of chronic distress rather than isolated discomfort (Ferreira et al., 2022, *as cited in* Groomer to Groomer, 2024).

Seksel (2014) also notes that anxiety-related illness in dogs often presents as recurrent medical issues, such as vomiting, diarrhoea, or dermatological flare-ups, that may be misdiagnosed as purely physical. These symptoms can stem from prolonged emotional strain, especially when dogs are repeatedly placed in environments that lack emotional safety or behavioural literacy.

The grooming context is uniquely challenging because it combines physical manipulation with sensory overload. Dogs may be handled by unfamiliar people, exposed to loud dryers, and restrained in ways that mimic past trauma. Without trauma-informed protocols, these experiences can reinforce stress pathways and contribute to long-term health deterioration (Seksel, 2014; Groomer to Groomer, 2024).

Boonhoh et al. (2025) also showed strong associations between physical disease and behavioural problems in dogs and cats, agreeing that chronic stress may suppress immune function, increasing vulnerability to illness and altering behaviour.

This underscores the need for welfare-focused grooming practices that recognise the physiological consequences of repeated emotional stress. Groomers should be trained to identify signs of chronic distress and adapt their techniques to minimise harm, especially for dogs with known behavioural sensitivities or medical histories.

2.9 Behavioural Typologies and HRV Mapping

The Canine Behaviour Type Index (CBTI) developed by Hutu et al. (2017) offers a multidimensional framework for categorising canine temperament, including traits such as sociability, excitability, and resilience. Reframed using ethological language, it supports individualised welfare assessment by recognising that dogs respond differently to grooming based on their behavioural predispositions (e.g., observable signals such as lip-licking, head turns, or withdrawal).

To enhance this framework, recent studies have explored the pairing of behavioural observation with physiological data, particularly heart rate variability (HRV), to assess emotional states in dogs. Nakahara et al. (2016) demonstrated that HRV can reliably classify canine emotions into positive, neutral, and negative states with up to 88% accuracy within subjects and 72% across subjects, using real-time data from wearable sensors. This suggests that HRV is a viable tool for mapping stress responses during grooming procedures (Nakahara et al., 2016).

Chi et al. (2020) developed a stress monitoring system that integrates HRV data with behavioural cues, allowing handlers to observe emotional states in real time via a mobile interface. Their “Bowow” system uses a scoring algorithm that correlates HRV fluctuations with observable behaviours such as panting, trembling, and avoidance, offering a practical model for welfare tracking in companion animals (Chi et al., 2020).

Building on these findings, this study proposes the development of a Grooming Stress Index (GSI), a scoring method that pairs behavioural typologies from the CBTI with HRV metrics. Dogs would be assessed across key behavioural domains (e.g., compliance, avoidance, vocalisation, posture) and scored against HRV readings taken during grooming phases (arrival, restraint, drying, release). The goal is to identify patterns of distress and resilience, enabling groomers to tailor handling techniques to individual welfare needs.

This integrative approach not only supports trauma-informed grooming but also provides a quantifiable method for tracking welfare over time. It bridges the gap between subjective behavioural interpretation and objective physiological data, offering a robust framework for ethical grooming practice.

2.10 Welfare Literacy and Psychological Framing

Welfare literacy refers to the ability of professionals to interpret animal behaviour through a psychologically informed lens, recognising signs of distress, trauma, and emotional dysregulation. In grooming contexts, this literacy is essential, not only for humane handling but also for preventing cumulative stress and long-term welfare deterioration. Neumyer Smith (2025) advocates for emotionally literate grooming practices that prioritise behavioural understanding, trauma sensitivity, and adaptive restraint techniques.

Trauma-informed grooming requires groomers to move beyond task-focused routines and adopt a framework that considers the emotional history and behavioural signals of each dog. Lotty, Kearns and Frederico (2024) emphasise that trauma-informed education leads to measurable changes in professional practice, with participants reporting increased empathy, behavioural awareness, and reduced reliance on coercive methods. Although their study focused on child welfare professionals, the principles are directly transferable to animal care settings, where emotional safety and relational trust are equally vital.

Bunting et al. (2019) argue that trauma-informed care is not simply a set of techniques, but a whole-system shift in mindset, one that requires practitioners to understand how repeated stress can shape behaviour, physiology, and coping capacity. In grooming, this means recognising that a dog's resistance may stem from past negative experiences rather than temperament, and that emotional shutdown or hypervigilance are not signs of defiance but indicators of distress and should be responded to appropriately with welfare considerations.

Howard et al. (2022) further note that trauma literacy involves understanding how internal and external factors influence an individual's experience of an event. For dogs, this includes breed predispositions, prior injuries, sensory sensitivities, and socialisation history. Groomers who are trained to interpret these variables can better tailor their approach, reducing the likelihood of re-traumatisation and promoting emotional recovery.

Ultimately, welfare literacy means not only recognising stress but responding with compassion and psychological insight. This commitment to individualised, emotionally informed care underpins the thesis's focus on heart rate variability and emotional regulation in professional dog grooming.

CHAPTER THREE - METHODOLOGY

3.1 Ethical Framework

This study was conducted under a welfare-led protocol designed to meet internationally recognised ethical standards, including principles outlined in the Animals (Scientific Procedures) Act 1986 (ASPA) and the Five Freedoms framework.
All data recording procedures were strictly non-invasive and are detailed in Annex C: **Ethics Framework.**
Field observation and data collection took place in a professional pet grooming salon in Seaford, East Sussex (UK) between January 2022 and December 2023 and written up in Sicily. Each of the 46 participating dogs *(n=46)* required individual owner instruction, signed consent, and a minimum period of habituation prior to grooming. Grooming, observational and data recording sessions were paced at approximately two dogs per day to ensure emotional safety and minimise stress. This extended timeframe reflects both the logistical demands of the study and its trauma-informed, welfare-led design.
While grooming is often described as routine, it involves inherently invasive procedures from a welfare perspective. Physical contact, restraint, exposure to unfamiliar stimuli, and sensory stressors such as noise and vibration can activate autonomic responses, particularly in dogs with trauma histories.
In this study, restraint was limited to slip leads, no use of muzzles and low-impact handling techniques, applied by a groomer trained in welfare-led practices. In addition, the grooming environment was intentionally calm, with reduced dog density and controlled noise levels to support emotional regulation. While this contrasts with the sensory intensity typical of many commercial grooming salons, the controlled setting was ethically necessary to isolate autonomic responses and uphold welfare-led research standards.

3.2 Stress Assessment Protocol

Stress was assessed using a dual-method approach combining physiological and behavioural data, supported by a composite scoring framework as shown in Table 2.

Table 2. Summary of stress assessment methods used in this study to interpret canine stress responses across grooming phases.

Assessment Domain	Data Measurement Tool	Purpose and Scope
Physiological	Heart Rate Variability: (RMSSD)	A validated biomarker of short-term parasympathetic activity, autonomic regulation, and emotional adaptability.
Behavioural	Canine Autonomic Stress Response (CASRI).	Using (CASRI), developed for this study to identify passive stress markers such as freezing, flattened affect, poor behavioural sequencing, gaze aversion, and withdrawal.
Physiological & Behavioural Integration	Grooming Stress Index (GSI):	A composite scoring tool integrating HRV and CASRI data to quantify overall stress levels across grooming phases and support trauma informed interpretation.

Where prior trauma histories were known, handling was adapted in accordance with trauma-informed principles to minimise distress. While this responsiveness may influence HRV outcomes, it reflects ethical best practice in welfare-led research. The emotional nature of the subject matter presents inherent challenges to standardisation, highlighting the need for methodological transparency and reflexivity in studies involving sentient participants.

3.2.1 Canine Autonomic Stress Response Index (CASRI)

To assess behavioural indicators of emotional dysregulation, this study developed the Canine Autonomic Stress Response Index (CASRI), a structured observational marker designed to identify both passive and active stress responses during grooming (Appendix D). CASRI captures two complementary domains of autonomic expression: Passive stress responses, including freezing, flattened affect, behavioural withdrawal, gaze aversion, and reduced behavioural sequencing. These behaviours are frequently misinterpreted as calmness or compliance, yet they often reflect emotional suppression and autonomic shutdown. Active arousal indicators—such as panting, trembling, sweating of the paws, fidgeting, and heightened startle responses—are often misinterpreted as “fidgety,” “difficult,” or “bad behaviour.” They reflect sympathetic activation and reduced emotional regulation.

CASRI scores were recorded across all grooming phases using a 5-point scale, with additional annotations for avoidance, hypervigilance, and shutdown behaviours. By distinguishing suppression from arousal, CASRI supports trauma-informed interpretation and provides a behavioural complement to physiological data collected via HRV monitoring.

3.2.2 Heart Rate Variability (HRV) RMSSD Monitoring and Interpretation

Heart rate variability was monitored using the Polar H10 chest strap, selected for its accuracy in short-term RMSSD readings and compatibility with canine physiology. All dogs were fitted with the monitor in a calm, low-stimulus environment prior to grooming, and baseline readings were taken during positive arousal (e.g., anticipation of a walk) to distinguish stress-related autonomic changes from general excitement. To support parallel habituation and minimise disruption, two heart rate monitors and two smartphones were used in tandem. This setup allowed for continuous data collection and flexible scheduling while reducing the risk of technical failure.

Heart rate monitors were then fitted upon arrival at the grooming salon. While this may have briefly elevated heart rate due to novelty or anticipatory arousal, baseline readings taken in the dogs’ home environments allowed for contextual interpretation. This helped distinguish environmental reactivity from procedural stress, particularly when comparing arrival-phase data with restraint and drying phases.

This contextual differentiation between baseline and procedural stress was central to the study’s interpretive framework. To illustrate the monitoring setup across environments, Figure 2 shows two dogs fitted with the Polar H10 monitor, one in a calm, non-grooming setting and one during nail trimming (Phase 3), providing visual reference for the HRV data collection process.

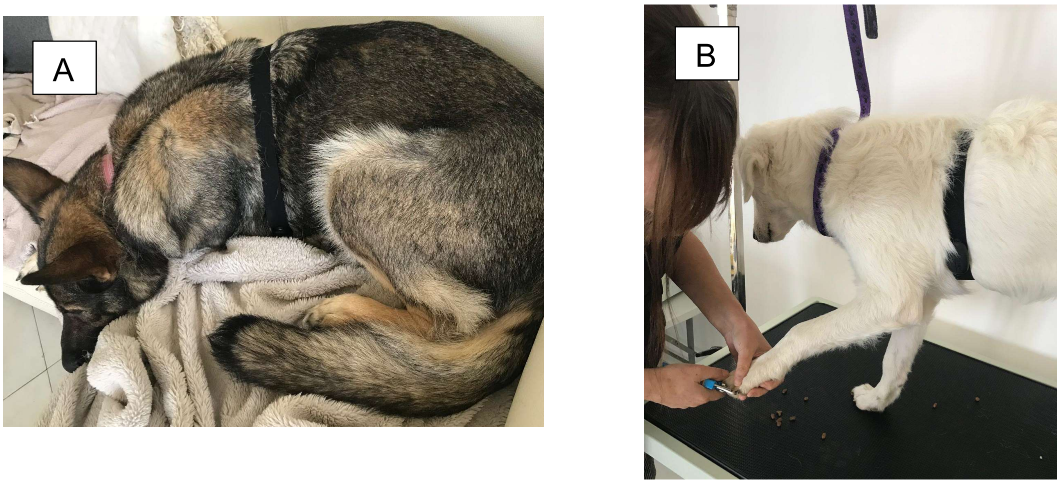

Figure 2 illustrates two dogs each fitted with the Polar H10 monitor A - in a calm, non-grooming environment (D025) and B during the grooming process (D021- P3), providing visual context for the HRV data collection protocol.

3.2.3 Grooming Phase Overview

To ensure consistency in HRV segmentation and behavioural coding, the grooming procedure was divided into seven distinct phases: arrival, restraint, nail trim, bathing, drying, clipper work, and scissor trimming. These phases reflect common procedural stages in commercial grooming and were selected based on their sensory load, handling intensity, and potential for emotional disruption. Each phase was treated as a discrete observational unit, allowing for targeted analysis of autonomic and behavioural responses. This structure also enabled comparison across dogs with varying trauma histories, breed traits, and treatment types. The following table summarises each phase and its activities.

Table 3. Overview of the seven grooming phases observed during HRV monitoring. Each phase represents a distinct procedural activity, from arrival to final release, allowing for behavioural and physiological stress assessment across the grooming sequence.

Phase No:	Phase Name:	Procedural Activity
P1.	Arrival	Dog enters salon, meets groomer, initial handling begins.
P2.	Restraint	Use of grooming slip lead and removal of lead and collar, lifted or step on hydraulic table and raise, positioning on table and tied to the cross bar using a 'quick release' knot.
P3.	Nail trim	Handling of feet and toes, clipping nails with use of a manual clipper tool.
P4.	Bathing	Rinse, shampoo and rinse again starting at the head toward the tail (working from clean to dirty).
P5.	Drying	Using an orange drying cloth and towelled by hand and further drying by 'forced air' dryer application (known as a blaster) or stand dryer.
P6.	Clipper work	Use of electric and / or battery handheld coat clippers.
P7.	Trimming and release	Use of various scissor types to trim and / or style the coat, including head and feet. Release includes spray with coat conditioner (scented), untied, step off from hydraulic table or lifted down from table, removal of slip lead and replaced with own collar and lead.

3.3 Sample Characteristics

A total of 46 (n = 46) companion dogs were recruited from a single grooming salon. Inclusion criteria required dogs to be healthy, non-sedated, and undergoing routine grooming. Dogs aged 1 to 12 years were selected to capture the full spectrum of adult behavioural and physiological development. This range reflects normative cognitive sequencing and welfare-relevant emotional regulation patterns, as identified in recent canine ageing research by Harvey (2021) and Li et al. (2025).

Table 4. Participant breakdown by age, sex, breed type, and trauma history. This grouping supported comparative analysis of behavioural and physiological stress responses across grooming phases.

Participant Breakdown:	
Age Range	1 to 12 years
Sex Distribution:	21 males & 25 females
Reproductive state:	36 spayed, 10 entire
Breed Types:	See text below
Trauma History:	
No known trauma (Low)	21
Mild trauma (Moderate)	18
Severe trauma (Severe)	7
This diversity allowed group analysis of behavioural and physiological stress responses across grooming phases.	

Owners completed a trauma history questionnaire (Annex B), and dogs were grouped by breed, age, and trauma exposure. Trauma classifications (Severe, Moderate, Low) were derived from owner reports, behavioural observations, and indicators of chronic stress. These categories supported comparative analysis but were not treated as clinical diagnoses. Instead, they reflect a welfare-led approach that emphasises emotional context and behavioural nuance over rigid classification. The following table outlines the criteria used to assign trauma classifications across the sample.

Table 5. Classification criteria used to assign trauma levels within the sample.

Trauma Level	Classification Criteria
Low Trauma (L):	No known exposure to significant adverse experiences, such as abuse, chronic neglect, major injury, persistent separation-related distress, or coercive training methods. The dog has a generally stable developmental history and consistent caregiving.

Moderate Trauma (M)	Exposure to mild or moderate adverse experiences, which may include rehoming, inconsistent or unpredictable caregiving, prolonged confinement, distressing medical procedures, or a history of inappropriate training or handling, such as the use of positive punishment or aversive techniques that have contributed to behavioural sensitivity or reduced resilience.
Severe Trauma (S):	Documented exposure to severe or prolonged adverse experiences, such as physical abuse, chronic neglect, forced isolation, or high-impact injury (e.g., vehicular trauma, dog-on-dog attacks). Dogs in this category may also have a history of intense or sustained coercive training practices, including repeated use of harsh positive punishment, leading to marked behavioural dysregulation, hypervigilance, or compromised coping capacity.

Reproductive status was recorded for all dogs and categorised as either spayed/neutered (s) or entire (e). While not used as a primary variable in this study, it was retained to support potential subgroup analysis.

For analytical purposes, age was treated as a categorical variable. Dogs were grouped into three age categories (1–3 years, 4–6 years, and 7+ years) to reflect developmental stages commonly used in canine behavioural and physiological research (Beerda et al., 1997; Romão et al., 2022; Zupan et al., 2016).

Age was recorded in whole years based on owner report, cross-checked where possible against veterinary records, microchip registration data, or grooming salon client files. Owner-reported age is widely used in canine behavioural research and provides reliable demographic information for adult dogs (Harvey, 2021). Age was treated as a continuous variable for descriptive purposes and as a grouping variable in comparative analyses of behavioural and physiological responses.

The sample included a diverse range of companion breeds, with clear representation across Kennel Club UK groups and designer categories. Gundog breeds were the most prevalent (n = 22), comprising Spaniels, Cocker Spaniels, Retrievers, and a Water Spaniel. Toy breeds formed the second-largest group (n = 10), including Shih

Tzus, Chihuahuas, and Pomeranians. Pastoral breeds were represented by two German Shepherd Dogs (n = 2), while the Working and Terrier groups each contained a single dog (Newfoundland and Border Terrier respectively; n = 1 per group). No Hound or Utility breeds were present.

Designer crossbreeds accounted for a substantial proportion of the cohort (n = 10), consisting of Cockerpoos and Labradoodles. One dog was recorded as a general crossbreed (n = 1). These classifications supported transparent reporting and enabled subgroup analysis in Chapter 4, although breed was not treated as a primary variable in the study's core analyses it is understood there may be a genetic predisposition to anxiety related responses.

3.4 Data Collection Procedures: Owner Instruction and Habituation Protocols

Data collection for this study involved the use of heart rate variability (HRV) monitors and structured behavioural observation across all grooming phases. To ensure consistency and minimise stress, owners were provided with detailed written instructions (Annex H) outlining the study's purpose, procedural steps, and welfare safeguards. These instructions supported standardised data collection while ensuring that dogs were introduced to the equipment in a calm, predictable manner.

To obtain reliable HRV data and reduce equipment-related stress, dogs completed a habituation period for wearing the HRV monitor. This involved short, non-invasive sessions in which the Polar H10 chest strap was gently fitted around the dog's thorax in familiar, low activity environments. The duration and structure of this protocol were informed by two key studies: Beerda et al. (1997), who recommended a minimum seven-day exposure period to reduce novelty-induced stress in behavioural research, and Romão et al. (2022), who demonstrated that a ten-day habituation period stabilised HRV readings in dogs fitted with wearable sensors. Drawing on this evidence, the present study adopted a ten-day habituation period to ensure that physiological responses reflected grooming-related stress rather than novelty or equipment discomfort.

To avoid influencing baseline HRV through reward anticipation or conditioned excitement, the habituation process was deliberately neutral and did not involve positive reinforcement. This approach aimed to minimise anticipatory arousal, reduce interference in physiological data, and ensure that HRV readings reflected genuine autonomic responses rather than emotional learning associated with the equipment.

In addition to equipment habituation, owners were asked to collect baseline HRV recordings across the same ten-day period to establish each dog's typical parasympathetic activity prior to grooming. Owners aimed to obtain one short recording (3–5 minutes) on most days, resulting in 8–12 baseline samples. Recordings were taken when the dog was calm and settled in a familiar environment, at approximately the same time each day to reduce circadian variation, and not immediately after feeding, exercise, or notable arousal. These baseline values were used to contextualise RMSSD changes observed during grooming and to support trauma-informed interpretation of autonomic regulation. The standardised recording sheet used during this phase is provided in Annex D2.

This preparatory phase, which combined equipment habituation with structured baseline HRV collection, was designed to minimise stress and improve the reliability of both behavioural and autonomic data gathered during grooming. The owner questionnaire provided a long-term behavioural baseline by capturing the dog's typical patterns of behaviour, stress responses, and coping style within the home environment. This subjective baseline reflects enduring behavioural tendencies rather than a moment-specific reading. In contrast, the 10-day habituation protocol established a physiological baseline through repeated HRV recordings, allowing autonomic activity to settle before grooming-phase measurements. These two baselines serve complementary functions: the questionnaire offers contextual behavioural history, while the HRV record sheet documents short-term physiological readiness for assessment.

After the habituation period and baseline data collection were completed, all dogs were scheduled for their grooming session. A minimum interval of 3–5 days was maintained as much as possible between the final habituation session and the grooming appointment. This buffer provided adequate time for autonomic recovery, reduced the risk of carry-over effects from the habituation routine, and ensured that dogs arrived at the grooming appointment in a calm, settled condition as much as possible, where HRV and behavioural data were then recorded using the equipment described in Section 3.5.

3.5 Equipment, Software and Environmental Controls

Equipment & Software

- Polar H10 heart rate monitor and chest strap (2 units)
- Spare CR2032 battery
- Samsung Galaxy S21 smartphone (2 units)
- Grooming tools and accessories with sensory impact considerations (Annex G)
- Canine Autonomic Stress Response Index (CASRI) behavioural checklist (Annex D)
- Grooming Stress Index (GSI) scoring sheet (Annex E)
- BIOPAC Systems Inc. HRV interpretation guidelines
- Owner instruction sheet and trauma history questionnaire (Annex B and H)
- Owner consent form (Annex A);
- Kubios HRV Scientific Lite Version 4.2.0,
- Encrypted local database with anonymised identifiers for data storage
- Baseline HRV recording sheet and pre-grooming behavioural assessment sheet (Annex D2 and D3).

Equipment Usage

- Two smartphones were used to host the HRV monitoring app and collect data via Bluetooth from the Polar H10 sensors. Each device was isolated from personal accounts and cellular networks to ensure data integrity.
- Spare batteries were maintained to prevent data loss during extended grooming sessions or habituation periods.
- Grooming equipment (varied by dog; categories consistent across sessions; sensory-impact considerations detailed in Annex G)
- The CASRI checklist and GSI scoring sheet were used to document behavioural and physiological stress responses, supporting trauma classification and welfare interpretation.

- The Owner Consent Form ensured ethical participation and transparency in data collection.
- Standardised data-recording forms (Annex D2–D3) were utilised to ensure consistent and accurate collection of baseline HRV measurements and pre-grooming behavioural observations.

In addition to HRV monitoring and behavioural observation, attention was given to the sensory and equipment-related factors present during grooming. Standardised tools such as high-velocity dryers (blasters) and plastic bathing stations were used across sessions to maintain consistency. Observational notes were also taken regarding grooming equipment with potential to influence stress reactivity, including slicker brushes, electric clippers, scissors, and nail clippers. These tools were flagged for their sensory impact and potential to elicit anticipatory responses based on prior experiences, supporting a trauma-informed approach to environmental and procedural assessment.

All HRV data were processed in Kubios HRV Scientific Lite using its automatic artefact-correction function to remove movement-related errors and ensure that RMSSD values reflected true autonomic activity.

BIOPAC Systems Inc. HRV interpretation guidelines were consulted only for basic orientation on HRV reading procedures.

Environmental Controls

Environmental controls were informed by the BIOPAC Lab Best Practices Guide (BIOPAC Systems, Inc., n.d.), which outlines best-practice strategies for managing sensory conditions during physiological data collection. To minimise external stressors and promote consistency across grooming sessions, adaptations were made to reflect both the practical realities of the salon and the welfare needs of the dogs. Auditory stimuli from standard grooming equipment were unavoidable, but the overall soundscape was moderated by limiting the number of dogs present and maintaining a calm, low-traffic environment. Sessions involved only the researcher and a groomer trained in animal learning theory and canine handling skills, whose communication style supported emotional regulation and cooperative behaviour. This differed markedly from standard industry practice, where verbal cues may be inconsistent or emotionally loaded.

Scent control was maintained by avoiding perfumes, food, and aromatic cleaning products, ensuring a neutral olfactory environment. Visual stimuli were reduced through neutral décor, the removal of mirrors and distracting images, and a clean, uncluttered space. Professional, neutral, unobtrusive clothing and calm body language were adopted. Technical jargon was avoided in owner communication to minimise emotional loading, prevent anxiety, and maintain a calm, predictable interaction for both dog and handler, for example the term “sensor” were used in place of “electrode” to prevent misinterpretation or anxiety.

3.6 Data Collection and Analysis Plan

This section outlines the overall data collection timeline, the synchronisation of HRV and behavioural data, and the analytical methods used to interpret the results. Further procedural detail is provided in Sections 3.4 and 3.5, with supporting materials in Annexes D–H. Pearson’s correlation coefficients were calculated to examine relationships between HRV (RMSSD) metrics and CASRI scores.

Data were collected in real time across all seven grooming phases, with RMSSD readings synchronised to behavioural scoring using the Canine Autonomic Stress Response Index (CASRI). Observational notes captured environmental conditions, canine responses, and notable events such vocalisation, or freezing. Impedance checks (via the HRV app’s signal-quality indicator) were conducted prior to each recording to ensure clear signal acquisition and reduce artefacts, supporting reliable physiological data capture in a grooming salon environment.

Statistical analysis was conducted using Kubios HRV Scientific Lite Version 4.2.0 and Jamovi (Version 2.7.6), an open-source statistical platform built on R. Kubios was used to extract RMSSD values for each grooming phase, applying its automatic artefact-correction function to remove movement-related errors and ensure that HRV values reflected true autonomic activity. Jamovi was selected for its accessibility, transparency, and alignment with the study’s ethical commitment to open and replicable research practices. Pearson’s correlation coefficients were then calculated to examine relationships between RMSSD and CASRI scores.

Analysis Overview:

The analysis followed a mixed-methods framework integrating physiological, behavioural, and contextual data to evaluate canine stress responses across grooming phases. Physiological analysis focused exclusively on RMSSD, a time-domain HRV metric that reflects short-term parasympathetic activity and is widely used in canine stress research due to its sensitivity to rapid autonomic shifts (Scheibe et al., 2015; Zupan et al., 2016). RMSSD values were extracted for each grooming phase using the Polar H10, a device validated for reliable HRV acquisition in dogs (Valença et al., 2024).

Behavioural analysis was conducted using the Canine Autonomic Stress Response Index (CASRI), developed for this study to identify passive stress indicators such as freezing, flattened affect, gaze aversion, poor behavioural sequencing, and withdrawal. CASRI scores were assigned for each grooming phase and used to characterise patterns of emotional suppression and autonomic distress.

To integrate physiological and behavioural findings, the Grooming Stress Index (GSI) was calculated as a composite measure combining RMSSD and CASRI scores. This allowed for a multidimensional assessment of stress that captured both autonomic regulation and observable behavioural responses. The GSI supported trauma-informed interpretation by highlighting phases where physiological suppression and behavioural inhibition co-occurred.

3.7 Grooming Stress Index (GSI) Scoring Framework

The Grooming Stress Index (GSI) was developed for this study as a composite measure integrating autonomic data (RMSSD) with behavioural indicators of suppression and emotional dysregulation. Its purpose is to provide a multidimensional representation of canine stress across grooming phases, capturing both internal physiological shifts and outward behavioural presentation. This approach reflects trauma-informed principles by recognising that dogs may exhibit reduced movement, passivity, or compliance while still experiencing significant autonomic stress.

Autonomic Component (RMSSD)

RMSSD values were interpreted relative to each dog’s 10-day baseline.

- **Low RMSSD** contributes positively to the GSI, indicating reduced parasympathetic activity, diminished regulatory capacity, and heightened autonomic stress.
- **High RMSSD** contributes negatively to the GSI, reflecting stronger vagal tone and greater emotional stability.

Behavioural Component (CASRI-linked indicators)

Behavioural scoring was informed by the Canine Autonomic Stress Response Index (CASRI) and adapted for grooming-specific contexts. Indicators included:

- behavioural suppression (e.g., freezing, immobility, reduced engagement)
- displacement behaviours (e.g., nose-licking, yawning, gaze aversion)
- sensory-triggered responses (e.g., flinching, withdrawal, tension)
- loss of expected behavioural sequences (e.g., failure to shake off water)

Higher behavioural suppression scores contribute positively to the GSI, indicating greater emotional shutdown or coping fatigue.

Combined Interpretation

The GSI integrates both components to reflect the dog's overall stress state during each grooming phase.

- **Low RMSSD + high behavioural suppression** produces a **high GSI**, signalling significant autonomic dysregulation and emotional risk.
- **High RMSSD + low behavioural suppression** produces a **low GSI**, indicating stable regulation and minimal distress.
- Mixed patterns produce **medium GSI** values, suggesting partial coping or early signs of emotional overload.

GSI Interpretation Framework

Table 6. summarises how overall GSI ranges were interpreted within the grooming context.

Table 6. Grooming Stress Index (GSI) Interpretation Framework

GSI Range	Interpretation
Low GSI	Strong parasympathetic regulation with minimal behavioural suppression; the dog appears emotionally stable within the grooming context
Medium GSI	Mixed autonomic and behavioural responses; the dog may be coping but showing early signs of stress or emotional fatigue.
High GSI	Reduced parasympathetic tone and marked behavioural suppression; indicates significant autonomic stress requiring trauma-informed handling and environmental adjustment.

CHAPTER FOUR - RESULTS

This chapter presents findings from physiological and behavioural data collected across seven grooming phases. Results are organised into four sections: (1) RMSSD patterns across grooming phases, (2) behavioural suppression markers scored via the CASRI framework, (3) correlations between autonomic and behavioural indicators, and (4) subgroup analysis by trauma history, age, and breed category. Data are anonymised and presented in aggregate, with illustrative behavioural examples drawn from Annex D (CASRI Checklist) and physiological summaries referenced from Annex F (Sample HRV Data Sheet). Visual comparisons are provided through Figures 3 and 4, which depict HRV trends and measurements across grooming phases.

GSI Interpretation Framework

RMSSD values across the seven grooming phases are presented to illustrate short-term parasympathetic activity and emotional regulation. GSI scores were calculated for each phase to provide a composite measure of autonomic stress.

Table 7. Average RMSSD milliseconds. Across Grooming Phases (short-term parasympathetic activity) and interpretation.

Grooming Phase	**Average RMSSD (ms)*	*Interpretation*
P1. Arrival	*52.4*	Lower stress — strong regulation
P2. Restraint	*44.1*	Moderate stress — mild withdrawal
P3. Nail Trim	*37.6*	Moderate stress — reduced regulation
P4. Bath	*32.8*	Elevated stress — autonomic strain
P5. Dry	*30.1*	High stress — parasympathetic suppression
P6. Clipper Work	*32.2*	Elevated stress — sympathetic dominance
P7. Trimming	*35.4*	Moderate stress — partial recovery

* Lower average values indicate reduced vagal tone and heightened stress response.

RMSSD values declined progressively across the seven grooming phases. The highest RMSSD was recorded during arrival (P1: 52.4 ms). Values decreased during restraint (P2: 44.1 ms) and nail trimming (P3: 37.6 ms). This downward pattern continued through bathing (P4: 32.8 ms) and reached its lowest point during drying

(P5: 30.1 ms). Clipper work (P6: 32.2 ms) showed a slight increase from the drying phase, and trimming (P7: 35.4 ms) showed a further increase.

Across grooming phases, RMSSD values were highest at arrival and lowest during drying and clipper work, with trimming showing the greatest increase following these procedures.

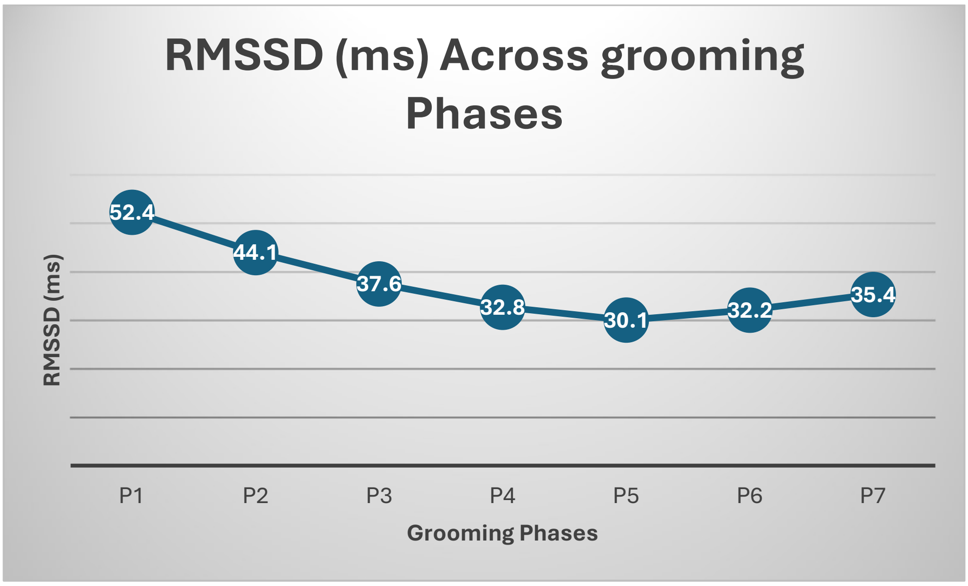

Figure 3. Line graph showing Root Mean Square of Successive Difference in milliseconds, (RMSSD) across grooming phases. RMSSD decline during restraint and drying.

Figure 4 presents the same data in a grouped bar format, providing an alternative visual layout that allows the magnitude of each phase to be compared more easily alongside the line-based trends shown in Figure 3.

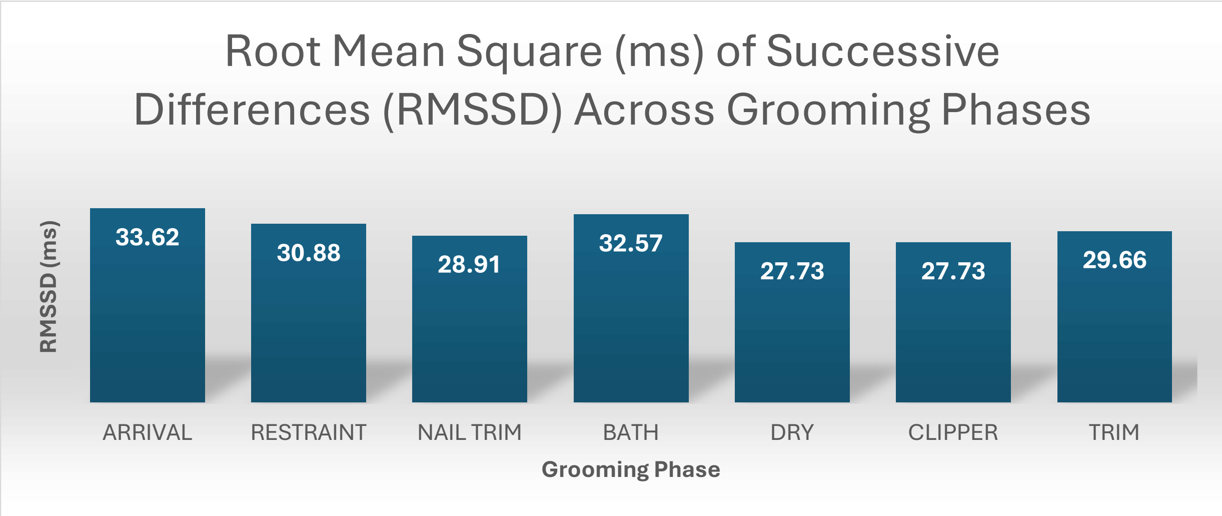

Figure 4. Bar Chart: Root Mean Square of Successive Differences (RMSSD) Across Grooming Phases

4.2 Behavioural Suppression Scores (CASRI)

Behavioural data were evaluated using the Canine Autonomic Stress Response Index (CASRI), scored from 0 (none) to 5 (severe). Suppression scores reflected passive behavioural responses such as freezing, reduced social signalling, gaze avoidance, and impaired behavioural sequencing. These behaviours were recorded across all grooming phases and summarised using phase-level CASRI averages.

Observed Trends

Behavioural suppression markers were recorded across all seven grooming phases. CASRI scores ranged from 0 to 5, with phase-specific variation in frequency and intensity.

Phase Level Patterns

- Restraint (P2) showed the highest frequency of freezing behaviours, recorded in 18 dogs (39%).
- Clipper Work (P6) showed the highest number of CASRI 4–5 scores, with 14 dogs (30%) displaying flattened affect or immobility.
- Nail Trim (P3) produced gaze aversion in 21 dogs (46%), the most common behavioural marker in this phase.

- Drying (P5) showed reduced behavioural sequencing in 17 dogs (37%), including delayed or absent shake-off behaviours (a normal and expected behavioural routine)
- Arrival (P1) had the lowest suppression scores overall, with 83% of dogs scoring CASRI 0–1.
- Trimming (P7) showed the highest proportion of CASRI 1–2 scores, with 26 dogs (57%) displaying mild suppression markers.
- Trauma related distribution (descriptive only)
- Dogs classified with severe trauma histories (n = 6) showed CASRI 3–5 scores in four or more phases.
- Dogs with no recorded trauma history (n = 18) showed CASRI 0–2 scores in five or more phases.
- Reduced behavioural sequencing was recorded in 6 dogs (13%), all within the severe trauma subgroup.
- Marker specific frequencies
- Freezing: observed in 22 dogs (48%) at least once across the grooming sequence.
- Flattened affect: recorded in 15 dogs (33%), most commonly during Clipper Work.
- Gaze aversion: observed in 29 dogs (63%), appearing across all phases except Arrival.
- Reduced social signalling: recorded in 18 dogs (39%), with the highest frequency during Drying.
- Impaired behavioural sequencing: recorded in 11 dogs (24%), with phase clustering in Nail Trim and Drying.

See Annex C for the full CASRI scoring rubric and Annex D for raw behavioural data.

4.3 Correlations Between HRV and Behaviour

Correlation analysis examined the relationship between RMSSD and CASRI scores across grooming phases. RMSSD showed a negative correlation with CASRI ($r = -0.62$, $p < 0.01$). Figure 5 displays individual RMSSD values plotted against CASRI scores, with a linear negative trend ($R^2 = 0.93$) and the fitted regression equation:

y=-0.1381x+5.9844

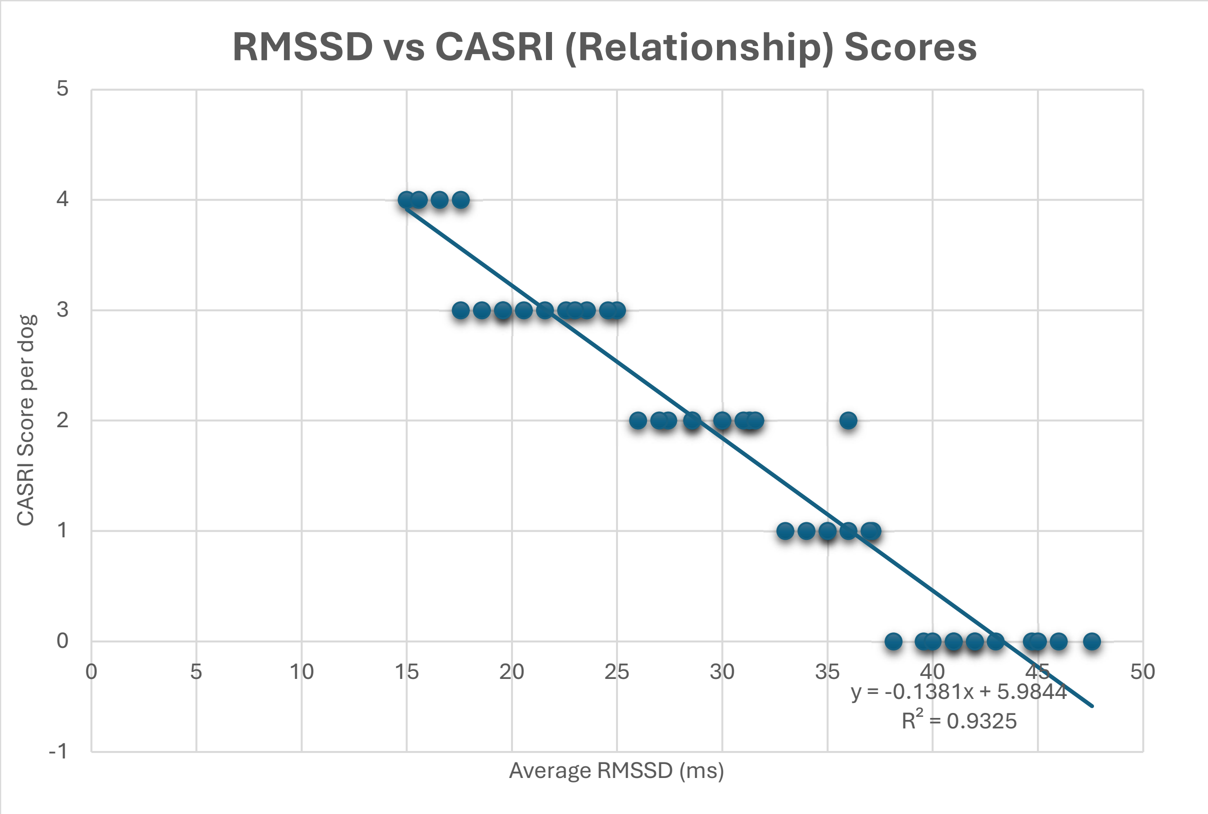

Figure 5. Scatter plot of RMSSD vs CASRI scores, displays the relationship between RMSSD (Root Mean Square of Successive Differences, ms) and behavioural stress scores derived from the CASRI framework. Each point represents an individual dog's RMSSD value plotted against its corresponding CASRI score. The fitted trendline and regression equation (y = –0.1381x + 5.9844) and R^2 value (0.93) are shown to illustrate the linear association between the two variables

A Pearson correlation heatmap (Figure 7) was generated to examine broader relationships between physiological, behavioural, and contextual variables across grooming phases. RMSSD showed moderate positive correlations across all HRV phases (r = 0.58–0.62) and a moderate positive association with age (r = 0.47). Age was also strongly correlated with the final trim phase (r = 0.61). When behavioural variables were included, RMSSD demonstrated moderate negative correlations with all CASRI components, including Arrival (r = –0.62), Restraint (r = –0.62), Nail Trim (r = –0.59), Bath (r = –0.62), Dry (r = –0.62), Clipper (r = –0.62), and Trim (r = –0.58).

Age was negatively correlated with CASRI scores (r = –0.61 to –0.66), and the CASRI components themselves were highly intercorrelated (r = 0.97–1.00). Together, these patterns illustrate the strength and direction of linear associations between physiological regulation, behavioural expression, and grooming context.

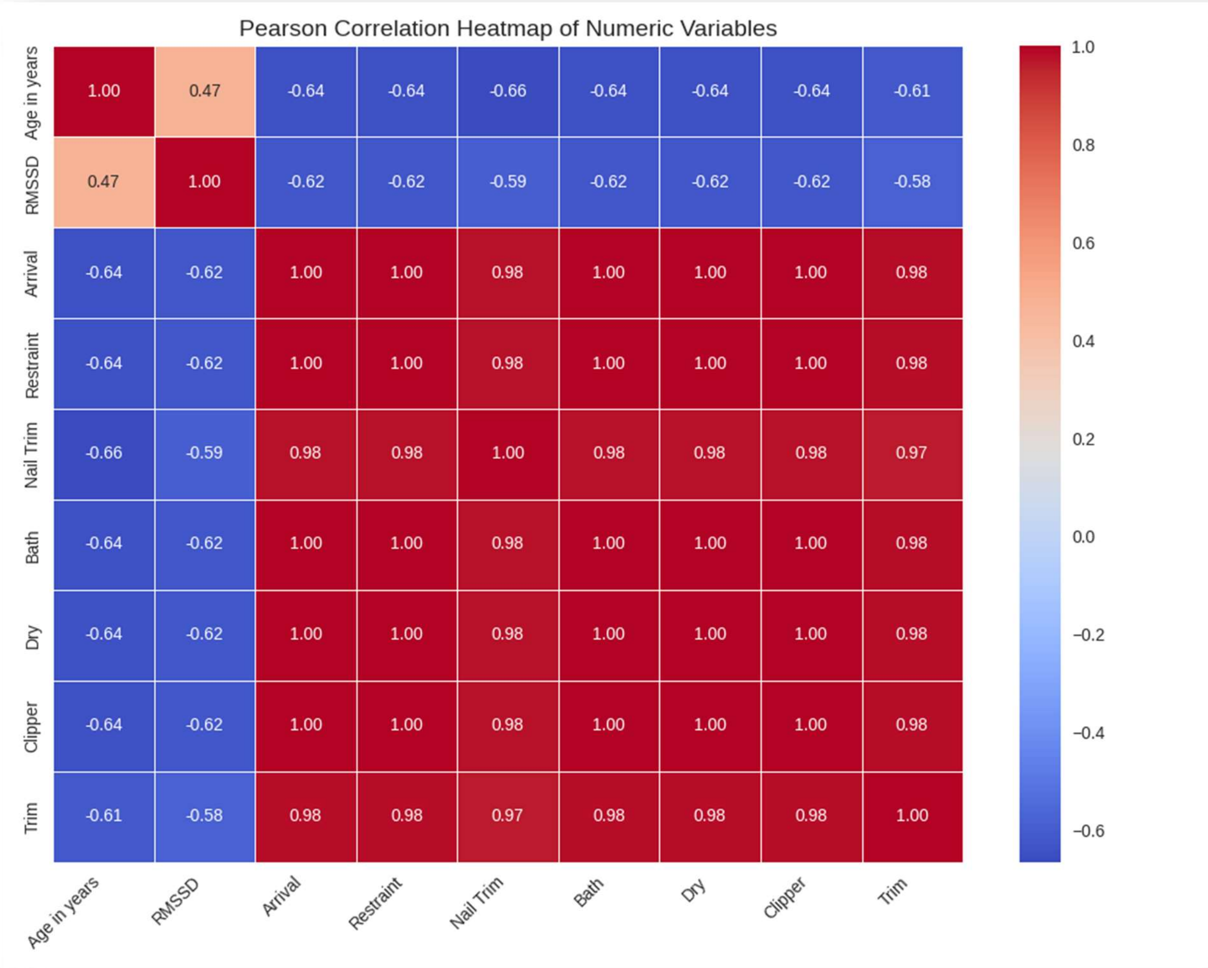

Figure 6. Pearson correlation heatmap of RMSSD, age in years and CASRI components, across grooming phases. Red shading represents positive correlations, and blue shading represents negative correlations, with colour intensity corresponding to the magnitude of the coefficient. Numerical values are shown within each cell to indicate the exact correlation for each variable pair.

4.4 Subgroup Analysis: Trauma History, Age, Breed Type

Subgroup analyses were conducted to examine variation in RMSSD, CASRI scores, and GSI values across trauma history, breed type, and age categories. The GSI was derived from standardised RMSSD values to support visual comparison of physiological responses across individuals and grooming phases.

Across the sample, GSI values were highest during the restraint and drying phases, with similar patterns observed within all subgroups.

Trauma History

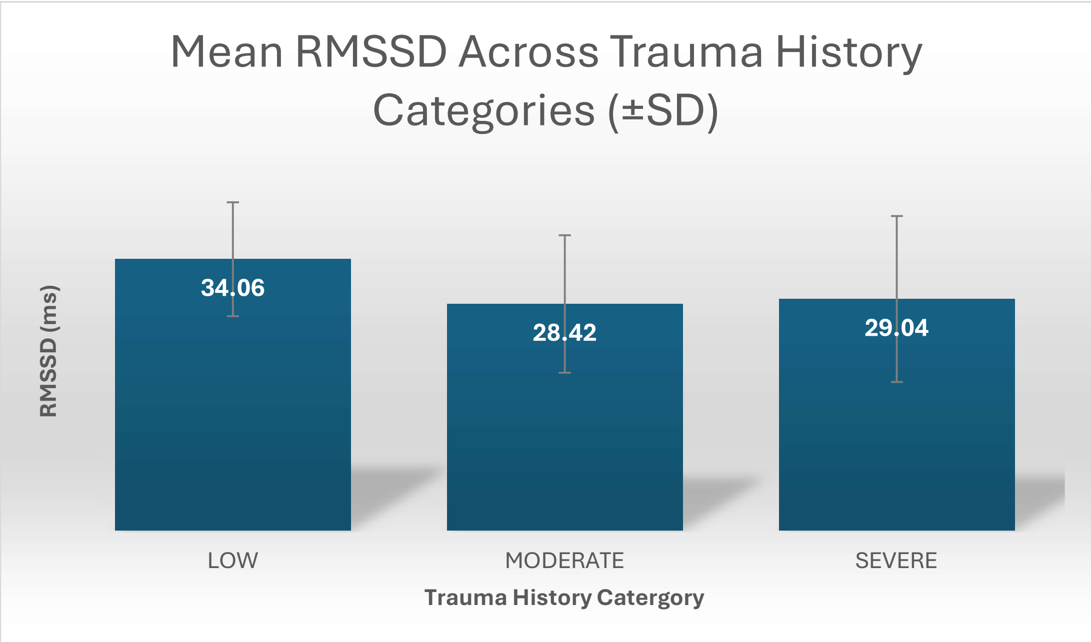

Figure 7. Mean RMSSD Across Trauma History Categories (±SD) Mean RMSSD values for dogs with low, moderate, and severe trauma histories. Error bars represent standard deviations.

Dogs were grouped into Low (n = 15), Moderate (n = 18), and Severe (n = 7) trauma categories. Mean RMSSD values were highest in the Low trauma group (M = 34.06 ms, SD = 7.14), followed by Severe (M = 29.04 ms, SD = 10.42) and Moderate (M = 28.42 ms, SD = 8.63). CASRI scores showed the opposite pattern, with higher values in dogs with Moderate and Severe trauma histories. These differences were consistent across grooming phases.

Age Category

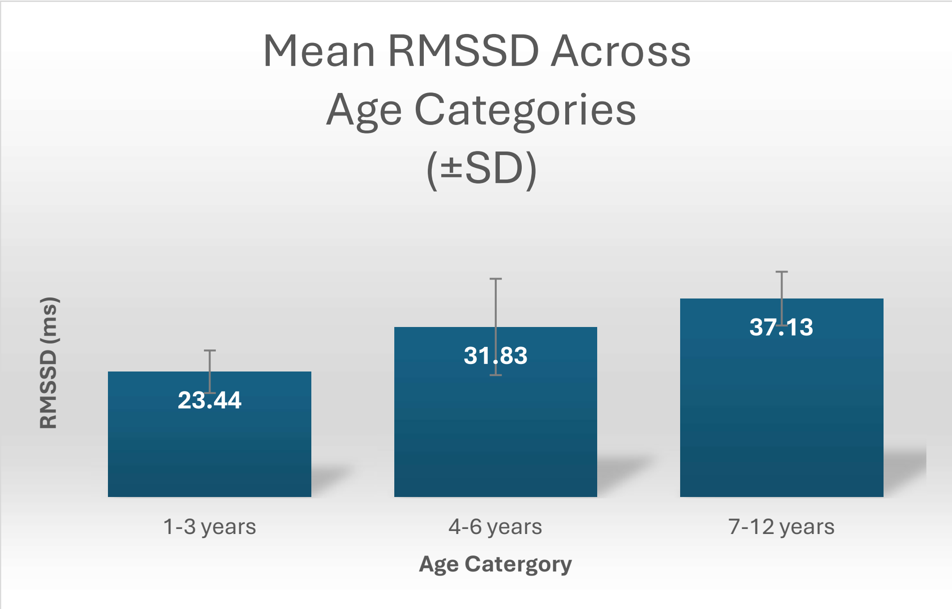

Figure 8. Mean RMSSD Across Age Categories (±SD), values for dogs aged 1–3 years, 4–6 years, and 7–12 years. Error bars represent standard deviations.

Dogs were grouped into three age categories: 1–3 years (n = 13), 4–6 years (n = 12), and 7–12 years (n = 15). RMSSD values increased with age, with the youngest group showing the lowest mean RMSSD (M = 23.44 ms, SD = 4.01), followed by 4–6 years (M = 31.83 ms, SD = 9.05), and 7–12 years (M = 37.13 ms, SD = 5.03). CASRI scores showed a corresponding decrease with age.

Breed Category

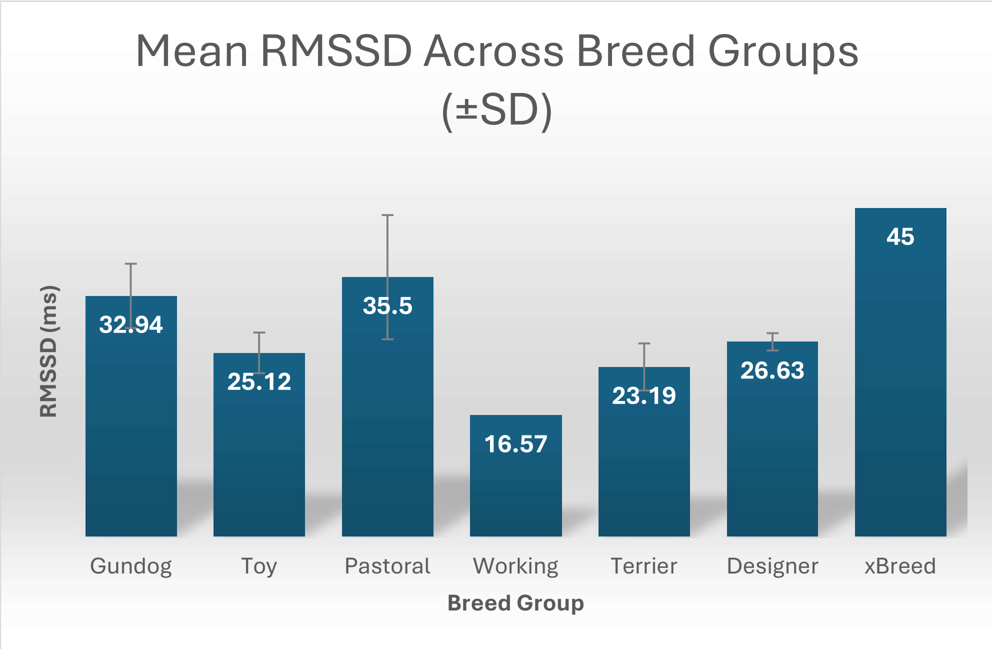

Figure 9. Mean RMSSD Across Breed Groups (±SD), values for dogs grouped by breed type. Designer mixes and the single crossbreed were reported separately. Error bars represent standard deviations.

RMSSD values differed across breed groups, although these comparisons are descriptive only due to uneven sample sizes. Pastoral and Gundog dogs showed the highest parasympathetic activity overall (Pastoral: M = 35.50 ms, SD = 8.51; Gundog: M = 32.94 ms, SD = 4.42), while Toy, Terrier, and Designer groups displayed lower but broadly comparable values (Toy: M = 25.12 ms, SD = 2.79; Terrier: M = 23.19 ms, SD = 3.22; Designer: M = 26.63 ms, SD = 1.18). The Working group (n = 1) showed the lowest RMSSD (16.57 ms), and the single crossbreed exhibited the highest value (45.00 ms). These patterns suggest meaningful variation between breed types, though interpretation is limited for groups represented by only one dog.

CHAPTER FIVE - DISCUSSION

5.1 Interpretation of Findings

The findings of this study provide support for the alternative hypothesis (H_1), indicating that grooming procedures elicit measurable autonomic and behavioural stress responses in dogs. These effects were particularly pronounced in individuals with trauma histories, brachycephalic breeds, and older age groups.

Across the sample, reductions in RMSSD during restraint and drying phases indicated diminished parasympathetic activity and reduced capacity for physiological recovery. This pattern aligns with established literature on stress reactivity and emotional shutdown in companion animals (Beerda et al., 1997; Maier & Seligman, 2016). Although HRV cannot diagnose emotional states, the consistent RMSSD reductions during specific grooming phases suggest that these procedures impose a measurable autonomic load.

The Grooming Stress Index (GSI), developed to integrate RMSSD changes with behavioural observations, provided a practical way of visualising welfare risk across subgroups. Dogs with prior trauma, brachycephalic morphology, and older individuals consistently scored higher on the GSI, indicating greater autonomic strain. Several dogs also showed reduced RMSSD upon arrival compared to baseline, suggesting anticipatory arousal. However, GSI scores during restraint and drying were consistently higher than arrival values, indicating that procedural elements contributed additional stress beyond initial environmental reactivity.

Behavioural responses such as tension, avoidance, and heightened vigilance around grooming equipment may reflect learned associations with prior discomfort or restraint. This interpretation is supported by Bragg et al. (2015), who found that dogs placed on weighing scales prior to veterinary consultation exhibited elevated cardiovascular responses, demonstrating that environmental cues alone can trigger physiological stress. Grooming environments share several sensory features with veterinary settings, such as disinfectant odours, metal surfaces, and close handling, which may contribute to anticipatory anxiety, particularly in dogs with prior medical or grooming experiences.

The findings also support the hypothesis that behavioural suppression during grooming is often misinterpreted as compliance, masking underlying distress. Pairing HRV metrics with behavioural observations enabled a more nuanced interpretation of canine coping strategies, reinforcing the need for emotionally literate welfare assessment in grooming contexts (von Borell et al., 2007; Zupan et al., 2016; Thayer & Lane, 2000).

However, HRV must be interpreted cautiously. RMSSD is sensitive but not specific: reductions may reflect general arousal, physical effort, or attentional load rather than distress alone. von Borell et al. (2007) emphasise that HRV should always be contextualised with behavioural and environmental data to avoid misclassification. Similarly, behavioural suppression does not always indicate trauma; Rooney et al. (2007) note that passivity may reflect habituation, temperament, or learned compliance, particularly in breeds selected for low reactivity.

Breed and age also introduce interpretive complexity. Palestrini et al. (2010) report that brachycephalic breeds and older dogs often exhibit reduced vagal tone independent of emotional distress. This highlights the importance of interpreting physiological baselines within a broader framework that includes morphology, sensory load, and individual history.

Taken together, these findings reinforce the alternative hypothesis and strengthen the case for grooming practices guided by emotional awareness and welfare science. They also highlight the value of combining physiological and behavioural data to support trauma-informed care and reduce misinterpretation of canine coping strategies.

Illustrative Cases

Luna (D001)

Mild suppression during Bath (CASRI = 2), with lip licking and gaze aversion.

Interpretation: Luna's physiological profile is consistent with mild suppression. Her RMSSD remained within a range typical of low trauma and adaptive regulation, while her behavioural signs (lip licking, gaze aversion) indicate subtle stress without significant autonomic compromise.

Max (D002)

Severe suppression during Clipper phase (CASRI = 4), with freezing and flattened affect. Interpretation: Max's profile supports the severe suppression classification. His reduced RMSSD aligns with his trauma history and the behavioural indicators of shutdown observed during the Clipper phase, a procedure associated with higher sensory and tactile load.

5.2 Implications for Grooming Practice

The findings of this study have direct implications for professional grooming protocols, particularly in relation to restraint, environmental design, and welfare assessment.

Restraint equipment such as grooming slings and the Groomers Helper® should be critically evaluated considering their potential to exacerbate stress responses, especially in dogs with trauma histories, sensory sensitivities, or physical vulnerabilities. While this equipment may facilitate task completion, their use without behavioural literacy risks reinforcing emotional shutdown and learned helplessness (Yin, 2009; Mariti et al., 2015; Overall, 2013). Recent research indicates that many dogs arrive at grooming sessions already exhibiting elevated stress markers, suggesting that restraint may compound anticipatory anxiety rather than alleviate it This effect may be further amplified by dogs' ability to detect chemosignals associated with conspecific stress, as well as behavioural and potentially chemical stress cues from the groomer, meaning that the distress of one individual can influence the emotional state of others and contribute to a heightened baseline of arousal within the grooming environment..

Grooming environments should therefore be adapted to reduce sensory load and support emotional regulation. Minimising ambient noise, allowing for gradual acclimatisation, and avoiding rushed or forceful handling are fundamental to reducing stress during grooming. Beyond canine stress responses, the salon environment and groomer wellbeing play a critical role in welfare outcomes. Busy, noisy salons can create a compounding cycle of stress: dogs showing subtle distress may be misinterpreted as 'fidgety', prompting rushed handling. This misinterpretation not only compromises welfare but also heightens groomer stress, reducing attentiveness and perpetuating welfare risks.

Groomers should be trained to identify subtle behavioural indicators of distress, such as lip licking, yawning, muscular tension, and avoidance, even when overt resistance is absent (Mills et al., 2014; McDonald et al., 2022). These behaviours may reflect autonomic dysregulation and emotional suppression, particularly in dogs with prior negative grooming or veterinary experiences. Early habituation to grooming during the developmental period is critical for promoting resilience and compliance, while dogs unfamiliar with grooming require additional time and positive reinforcement to facilitate adaptation.

The integration of HRV monitoring and welfare scoring such as the Grooming Stress Index (GSI) offers a pathway toward more ethical, data-informed grooming practices. These can help identify dogs at higher risk of dysregulation and guide adjustments in handling, pacing, and restraint use. By pairing physiological data with behavioural observations, practitioners can move beyond surface-level compliance and toward emotionally literate care.

Manufacturers of grooming equipment also have a role in promoting welfare-aware practice. Metal bathing tubs, for example, may amplify sound and vibration, contributing to sensory overload and anticipatory stress. As outlined in Annex G, sensory input from equipment, including clipper noise, surface texture, airflow intensity, and restraint configuration, can significantly influence emotional reactivity. Welfare-oriented design, such as noise-dampening materials, adjustable restraint systems, and clear behavioural guidance at the point of sale, would support both groomers and dogs in achieving safer, more emotionally attuned outcomes.

In addition, the wider grooming culture, including practices modelled within the competitive show world, plays a significant role in shaping public expectations and influencing how students interpret “normal” grooming behaviour. Show-ring presentation often prioritises aesthetic outcomes over behavioural comfort, and some traditional techniques used in these contexts may inadvertently normalise handling methods that compromise welfare. Because many owners groom their own dogs for competition, these practices can diffuse into everyday grooming routines, reinforcing approaches that overlook sensory load, emotional safety, or species-appropriate handling. Addressing these cultural influences is therefore essential for developing a welfare-led grooming ethos that is consistent across both commercial and non-commercial settings.

These findings further highlight the need for a cultural shift in grooming education, from a task-centric model focused on efficiency toward a welfare-oriented model that prioritises emotional safety and behavioural literacy. This shift also requires rethinking how canine behaviour is interpreted. While breed-based assumptions remain common in grooming practice, the variability in autonomic stress responses observed across dogs of the same breed suggests that behavioural typologies may offer greater explanatory power than breed alone. The Canine Behaviour Type Index (Dagley & Perkins, 2007), which classifies dogs along psychological dimensions such as environmental order and social role, strengthens the case for integrating temperament-based frameworks into welfare assessment. Future research may benefit from combining HRV metrics with such typologies to refine predictive models of grooming-related stress.

Handling practices also warrant reconsideration. In many grooming contexts, dogs are repositioned, lifted, or restrained without preparatory cues, resulting in sudden shifts in posture and orientation. This lack of anticipatory signalling may exacerbate stress responses, particularly in older dogs or those with vestibular sensitivity (Barnes et al., 2025; Gnass, 2025; Jackson, 2025). Field observations revealed that dogs moved abruptly, without verbal or tactile warning, were more likely to exhibit freezing, tremors, or compensatory tension. These behaviours were often misinterpreted as non-compliance, yet they may reflect a breakdown in emotional safety and proprioceptive stability. Embedding preparatory cues into handling routines could mitigate sensory overload and support trauma-informed practice by allowing dogs to predict and prepare for transitions.

Groomers should therefore be equipped not only with technical skills but also with the capacity to interpret canine stress signals and adapt procedures accordingly. However, this shift raises practical and economic challenges. Welfare-led grooming may require longer sessions, more frequent breaks, or specialised equipment, factors that can increase operational costs. In a commercial market with no formal regulation or required qualification standards, some groomers may invest in trauma-informed care and charge accordingly, while others may undercut prices by prioritising speed over welfare. Owners may also be reluctant to pay for longer or more frequent sessions, particularly if the benefits of emotionally safe grooming are not clearly communicated. These tensions underscore the importance of public education, industry standards, and transparent communication about the value of welfare-led practice. Without these supports, emotionally literate grooming risks becoming a niche offering rather than a sector-wide norm.

Taken together, these findings strengthen the case for grooming practices guided by emotional awareness and welfare science. They also highlight the need for trauma-informed education, manufacturer accountability, and systemic reform to ensure that canine wellbeing is prioritised across the grooming industry.

5.2.2 Thermal Physiology, Heat Stress, and Educational Oversight

Thermal regulation in dogs is primarily achieved through panting, vasodilation, and limited sweat gland activity in the paw pads. Unlike humans, dogs lack widespread eccrine sweat glands, making them more vulnerable to environmental heat accumulation and equipment-induced thermal stress (Klemm, 2020). During grooming, heat exposure can arise from multiple sources, including warm water, ambient salon temperature, high-velocity dryers, and prolonged restraint. When combined, these factors may overwhelm the dog’s ability to dissipate heat, particularly in brachycephalic breeds, geriatric dogs, or those with cardiovascular compromise.

In this study, reductions in RMSSD during the drying phase were consistently observed across the sample, with the most pronounced changes occurring in dogs with trauma histories and older age profiles. While reduced RMSSD is often associated with emotional stress or autonomic dysregulation, it is important to recognise that thermal stress can also trigger parasympathetic withdrawal. Physiological responses such as panting, vasodilation, and increased cardiac output are adaptive mechanisms for heat dissipation (Klemm, 2020). Therefore, HRV data must be interpreted alongside environmental and procedural context to avoid misattributing heat-induced autonomic changes to behavioural stress alone.

These autonomic patterns, integrated into the Grooming Stress Index (GSI), revealed a clear trend of heightened physiological strain during heat-intensive procedures. Behavioural observations supported this interpretation: signs of passivity, immobility, and flattened affect emerged most frequently during drying, a phase commonly associated with high-velocity blaster use and elevated ambient temperatures. A 2022 case study published in the *Brazilian Journal of Animal Science* similarly reported that dogs exhibited their strongest physiological and behavioural stress responses during the drying phase, including panting, avoidance, and postural withdrawal.

Recent guidance from the British Isles Grooming Association (BIGA) highlights the risks of grooming during heatwaves, noting that heat stress, dehydration, and tool overheating are common hazards in salons lacking adequate ventilation and temperature control (BIGA, 2025). Recommendations include using cool or low dryer settings, testing tool temperatures on human skin before use, and shortening appointments during hot weather. However, these guidelines are not universally followed, particularly in salons where staff lack formal training in canine physiology or welfare.

Water temperature during bathing is another overlooked variable. While warm water may aid cleansing, excessive heat can elevate core temperature and induce vasodilation, potentially leading to hypotension and fatigue. In this study, dogs undergoing de-shedding and de-matting treatments, which often involve prolonged bathing and drying, showed notably higher GSI scores, suggesting that thermal load may compound procedural stress. Dogs with thick coats or compromised thermoregulation may retain heat post-bath, especially if drying occurs in poorly ventilated spaces. The risk is further amplified during summer months, when ambient temperatures may exceed 30°C and grooming rooms often lack air conditioning or passive cooling systems.

High-velocity dryers, already implicated in acoustic stress, also pose thermal risks. These devices can rapidly elevate skin surface temperature, particularly when used on localised areas such as the flank or groin. Without proper technique, including continuous movement, distance control, and temperature monitoring, dogs may experience thermal discomfort, dermal irritation, or heat stress. The drying phase consistently produced the highest autonomic stress scores across all subgroups in this study, reinforcing its role as a critical welfare inflection point

Despite these risks, there is no legal requirement for dog groomers to hold formal qualifications in the UK, and many operate without education in canine anatomy, physiology, or behavioural observation. While City & Guilds and iPET Network include welfare modules within their grooming curricula, these are not mandatory across the sector. Consequently, equipment misuse, poor maintenance, and failure to recognise signs of distress remain prevalent. This educational gap undermines welfare standards and increases the likelihood of trauma, particularly in vulnerable dogs.

The physiological findings of this study, including phase-specific autonomic dysregulation, elevated GSI scores, and behavioural suppression during heat-intensive procedures, support the need for mandatory welfare education, including modules on thermal physiology, acoustic safety, and behavioural literacy. Groomers must be equipped not only with technical skills but with the scientific understanding necessary to prevent harm and promote emotional recovery.

5.3 Psychological Literacy and Welfare Education

The findings of this study underscore the importance of psychological literacy within the grooming profession. Emotional suppression, trauma responses, and autonomic dysregulation are not commonly addressed in grooming curricula, yet they are central to understanding canine welfare. This study supports the inclusion of trauma-informed education in grooming certification programmes, emphasising behavioural interpretation, low-stress handling, and welfare literacy.

Welfare literacy involves more than recognising stress; it requires responding to it with compassion, skill, and psychological insight. Groomers equipped with this literacy are better positioned to prevent re-traumatisation, support emotional recovery, and foster trust with both dogs and their owners. The pairing of HRV data with behavioural observation offers a practical model for embedding psychological literacy into everyday practice (Lotty, Kearns & Frederico, 2024; Bunting et al., 2019; Howard et al., 2022).

Some critics may argue that psychological literacy lies beyond the scope of grooming education and risks overcomplicating vocational training. While this concern reflects practical constraints, emerging interdisciplinary models suggest that basic trauma-informed principles can be taught effectively without requiring clinical expertise (Lotty et al., 2024). Moreover, as grooming increasingly intersects with behavioural and welfare domains, the ethical imperative to understand emotional distress becomes harder to ignore.

This imperative extends beyond commercial grooming into the competitive show world, where welfare considerations are often overshadowed by aesthetic standards. Observations from high-profile events such as Crufts indicate that a proportion of dogs exhibit signs of dysfunctional regulation, including flattened affect, hypervigilance, and behavioural withdrawal. Reports of extreme presentation techniques, such as the use of flame to remove eyebrow hair, although rare and difficult to verify, illustrate how aesthetic priorities may normalise practices that compromise welfare. These examples highlight the need for welfare education across all grooming sectors, including show preparation.

Recent critiques of competitive grooming environments have called for greater transparency and regulation, noting that aesthetic conformity can conflict with welfare priorities (McGreevy et al., 2017). The absence of mandatory welfare training for show handlers and breeders perpetuates a culture in which emotional distress may be overlooked or misinterpreted as temperament. Integrating trauma-informed principles into show-grooming education could help shift the focus from visual perfection to emotional wellbeing, aligning presentation standards with ethical care.

Collectively, these findings support a sector-wide call for psychological literacy, not only in commercial grooming but across all domains where dogs are handled, restrained, or presented. Welfare education must evolve to reflect the emotional complexity of companion animals, ensuring that grooming practices promote not just compliance, but comfort, trust, and recovery.

5.4 Integration with Clinical Psychology Frameworks

This study situates grooming within a Clinical Psychology framework, offering a trauma-informed lens through which canine welfare can be interpreted. The use of heart rate variability (HRV) as a cross-species biomarker aligns with psychophysiological models of emotional regulation, in which autonomic balance reflects resilience, recovery, and the capacity to cope with environmental demands (Thayer & Lane, 2000; Siegel, 2020).

Patterns observed in this study, such as behavioural suppression, emotional shutdown, and phase-specific reductions in RMSSD, parallel responses documented in human trauma research, reinforcing the relevance of psychological constructs in interpreting animal behaviour. This interdisciplinary perspective supports the application of principles such as safety, predictability, trust, and emotional literacy to grooming contexts, thereby enhancing welfare assessment and ethical care.

However, the integration of human psychological models must be approached with caution. Critics such as Horwitz and Mills (2009) warn against anthropomorphism and conceptual overextension, emphasising that species-specific differences in cognition, sensory processing, and emotional expression must be respected. While Clinical

Psychology provides valuable conceptual tools, its application should be carefully adapted to canine ethology and veterinary behavioural science to avoid misinterpretation.

Viewed in this light, the findings of this study indicate that grooming-related stress in dogs aligns with core principles of trauma theory, highlighting the value of emotionally literate, welfare-focused practices grounded in psychological science.

CHAPTER 6 - CONCLUSION

6.1 Summary of Key findings

This research demonstrates that professional grooming procedures can elicit significant autonomic and behavioural stress responses in companion dogs, with the most pronounced effects occurring during restraint and drying phases. These findings are consistent with previous research by Beerda et al. (1997), Mariti et al. (2015), and Silva et al. (2022), who similarly identified elevated stress markers and behavioural suppression in dogs exposed to grooming or grooming-like environments.

This study set out to test the null hypothesis that grooming does not produce measurable changes in canine autonomic or behavioural stress responses. The findings clearly contradict this assumption, demonstrating significant shifts in RMSSD values, behavioural stress indicators, and phase-specific autonomic patterns across grooming sessions. The null hypothesis was therefore rejected, supporting the conclusion that grooming environments can meaningfully influence canine emotional and physiological states. These results reinforce the need for welfare-led, emotionally literate grooming practices and provide an empirical foundation for future research and policy development.

The analysis revealed trauma history, breed type, and age as important predictors of stress reactivity. Older dogs and those with prior trauma exhibited heightened vulnerability, aligning with the observations of McMillan et al. (2015), Harvey (2021), and Li et al. (2025), who reported comparable patterns of increased stress sensitivity in these groups. Brachycephalic breeds also showed distinct autonomic patterns, reflecting the influence of morphology on stress regulation

The integration of heart rate variability (HRV) metrics, specifically RMSSD, with structured behavioural observation provided a robust framework for identifying distress patterns. This combined approach supports the case for emotionally literate, welfare-led grooming practices, echoing the recommendations of von Borell et al. (2007), Zupan et al. (2016), and Mills et al. (2014), who emphasised the value of pairing physiological and behavioural indicators in welfare assessment.

This research identified frequent passive stress responses, including freezing and behavioural shutdown. These behaviours are widely misinterpreted as compliance in grooming practice, as noted by Maier & Seligman (2016) and Overall (2013). The patterns observed here reinforce the relevance of this concern and reinforce the need for greater behavioural literacy within grooming practice to avoid misclassification of emotional states.

6.2 Contributions to Knowledge

This research advances the understanding of canine welfare in grooming environments by integrating clinical psychology perspectives with empirical HRV and behavioural data. Building on the foundational work of Siegel (2020) and Thayer & Lane (2000), the study applies psychophysiological models of emotional regulation to the context of professional dog grooming—an area that has received limited empirical attention despite its relevance to companion animal welfare.

The development and application of the Grooming Stress Index (GSI) and Canine Autonomic Stress Response Index (CASRI) provide new, practical tools for assessing and interpreting stress responses in dogs. This approach extends the work of Chi et al. (2020) and Nakahara et al. (2016), who demonstrated the value of integrating physiological and behavioural indicators for welfare assessment, by adapting these principles specifically to grooming procedures and their associated sensory and handling demands.

The findings also challenge traditional assumptions about compliance, breed resilience, and the adequacy of current grooming practices. In line with the arguments of Mills et al. (2014), Bunting et al. (2019), and Lotty & Frederico (2024), the results highlight the need for trauma-informed approaches and ongoing welfare education within the grooming sector. The prevalence of passive stress responses observed in this study supports wider concerns that such behaviours may be misinterpreted as cooperation, reinforcing calls for emotionally literate, welfare-led practice.

Finally, the integration of objective physiological measures with nuanced behavioural observation, as advocated by Schneider & Schwerdtfeger (2020) and Valenza et al. (2024), underscores the importance of a multidimensional approach to welfare assessment. This thesis contributes to the field by offering a scientifically grounded, ethically robust framework that can inform both future research and practical improvements in animal care.

6.3 Recommendations for Practice

The findings of this study point to the need for systemic reform across the grooming sector, including national training requirements, welfare-led policy development, and improved public understanding of canine distress. In line with the recommendations of Neumyer Smith (2025) and Lotty, Kearns & Frederico (2024), grooming professionals would benefit from mandatory training in recognising and responding to canine stress. This includes the use of structured behavioural observation and, where feasible, physiological indicators such as HRV, as advocated by Mills et al. (2014) and Yin (2009). Such training would enable practitioners to move beyond surface-level compliance and towards emotionally literate, welfare-led care.

Grooming environments should be adapted to minimise sensory overload, with particular attention to noise, heat, and handling techniques that support emotional regulation, as emphasised by Scheifele et al. (2012), Klemm et al. (2020), and Mariti et al. (2015). Manufacturers also have a responsibility to prioritise welfare in equipment design, providing clear guidance on ethical use and maintenance (Dog Lover's Towel, 2025; British Isles Grooming Association, 2025). Improved design standards, such as noise-dampening materials, temperature-regulated showers and dryers, and ergonomically safe restraint systems, would support both practitioners and dogs.

A critical barrier to the adoption of welfare-led practices is the lack of owner awareness regarding canine distress and the value of emotionally safe grooming. As noted by McDonald et al. (2022) and Wan, Bolger & Champagne (2012), owners often underestimate their dogs' stress and may be reluctant to pay higher fees for longer, welfare-focused sessions, particularly when the benefits are not clearly communicated. This challenge is compounded by the prevalence of low-cost grooming services that prioritise speed and price over welfare and quality styling, undermining professional standards and making it difficult for practitioners to charge appropriate fees (McGreevy et al., 2017; McDonald et al., 2022).

To address these issues, public education campaigns and transparent communication about the benefits of welfare-led practice are essential (Neumyer Smith, 2025; Bunting et al., 2019). Owners should be provided with accessible information on recognising signs of canine distress and understanding what constitutes high-quality, welfare-led grooming (Tsao, 2023; British Isles Grooming Association, 2025). Only through a cultural shift that values emotional safety, professional expertise, and appropriate remuneration can the sector move towards truly compassionate and effective care for companion animals.

In summary, the implementation of mandatory welfare education, the integration of physiological and behavioural assessment tools, and the promotion of owner awareness are critical steps towards raising standards in the grooming industry. These recommendations, grounded in both the findings of this study and the broader literature, offer a pathway for meaningful and sustainable improvement in canine welfare.

CHAPTER 7 - LIMITATIONS AND FURTHER RESEARCH

7.1 Methological Constraints and Ethical Considerations

While this study offers a robust framework for assessing grooming-related stress, several methodological constraints must be acknowledged. The use of owner-led HRV recordings, although valuable for ecological validity and participant comfort, introduced procedural inconsistencies. Variability in device placement, timing, and environmental control may have influenced baseline readings, a limitation also noted in previous HRV research (Romão et al., 2022; Beerda et al., 1997). Providing owners with clearer guidance, visual aids, or structured onboarding sessions may enhance data reliability in future studies.

The decision to conduct owner questionnaires through researcher-led interviews was grounded in a trauma-informed, relational ethic (Bunting et al., 2019; Lotty & Frederico, 2024). While this approach enriched the qualitative data and supported rapport-building, it also introduced variability linked to researcher presence, tone, and perceived authority. Future research could benefit from comparing self-administered and researcher-administered formats to assess consistency and reduce interpretive bias (McDonald et al., 2022).

Ethical considerations also shaped the study design. Direct observation in less welfare-oriented salons was not pursued, as exposing dogs to distress without mitigation would conflict with trauma-informed principles (Neumyer Smith, 2025). Researchers must continue to balance scientific rigour with ethical responsibility, potentially drawing on retrospective data, owner-submitted recordings, or observational audits rather than direct intervention in ethically sensitive contexts.

7.2 Sample Diversity and Representation and Generalisability

The diversity of the sample, while encompassing a range of breeds, ages, and trauma histories, was limited by recruitment from a single grooming salon and the exclusion of dogs under one year of age. These factors may affect the generalisability of the findings, as certain breed types, developmental stages, and environmental contexts were underrepresented (Harvey, 2021; Li et al., 2025). Expanding sample diversity in future research, by including a broader range of breeds, ages, grooming environments, and owner backgrounds, would strengthen the external validity of welfare assessments (McMillan et al., 2015).

Additionally, the relational nature of owner participation and the use of trauma-history questionnaires provided valuable qualitative depth but also introduced variability. Incorporating post-session owner feedback forms could help capture owner experiences, perceived challenges, and interpretations of their dogs' responses, adding further nuance to physiological and behavioural data.

7.3 Opportunities and Challenges for Longitudinal Research

This study's cross-sectional design provided a valuable snapshot of canine stress responses during grooming but did not capture how these responses may change over time. Longitudinal research, tracking dogs' HRV and behavioural patterns across multiple grooming sessions or over extended periods, could clarify the effects of habituation, trauma recovery, or shifts in grooming practice (Romão et al., 2022; Zupan et al., 2016). Such data would offer critical insight into the long-term impact of grooming environments and interventions and would support the refinement of welfare protocols aimed at promoting emotional recovery and resilience.

Future studies may also compare the effects of different grooming protocols, equipment types, or educational interventions over time, providing a more dynamic and comprehensive understanding of canine welfare in practice. Longitudinal designs would therefore not only deepen scientific knowledge but also inform evidence-based improvements across the grooming sector.

7.4 Analytical and Behavioural Scoring Refinements

While the CASRI and GSI frameworks provided a structured foundation for coding autonomic and behavioural stress responses, it became clear that the behavioural scoring system used in this study, though functional, lacked the granularity needed to capture subtle shifts in canine stress across grooming phases. Several dogs exhibited nuanced changes in pupil dilation, ear posture, and spinal shape (curve or straight) that were not consistently recorded. As outlined in Annex J, the proposed layered Behavioural Scoring Framework integrates a five-point global stress scale with detailed autonomic and postural sub-scores mapped across grooming phases. This includes indicators such as mouth tension, tail position, vocalisation intensity, and collapse posture, each scored on a 0–2 scale to reflect frequency and severity

This refined framework builds on CASRI and GSI by offering a more context-sensitive approach to behavioural assessment, strengthening the case for trauma-informed welfare protocols that are both clinically robust and practically applicable (Schneider & Schwerdtfeger, 2020; Valenza et al., 2024). Future research should explore the reliability of this approach and its alignment with HRV metrics to enhance predictive accuracy and ethical care.

Additionally, the use of specifically designed grooming equipment, such as low-noise dryers, ergonomic restraints, and temperature-regulated tools, warrants ongoing HRV-based evaluation. Commercial claims of "stress-reducing" design should be empirically tested in real-world settings to assess their impact on autonomic regulation and behavioural outcomes (Scheifele et al., 2012; Dog Lover's Towel, 2025). Such evidence could inform welfare-led product development and guide practitioner purchasing decisions.

7.5 Policy Implications and Future Directions

The findings of this study highlight several policy gaps that warrant further investigation. At present, UK welfare legislation does not require groomers to hold formal qualifications in canine physiology, behavioural observation, or welfare-led practice (British Isles Grooming Association, 2025; McDonald et al., 2022). The autonomic and behavioural patterns identified in this research suggest that grooming carries welfare risks that are not fully recognised within existing regulatory frameworks. Future research could therefore play a critical role in informing policy development by generating evidence on the effectiveness of welfare-led training, equipment standards, and environmental controls. Longitudinal and multi-site studies would be particularly valuable in establishing the conditions under which grooming becomes emotionally safe, and in identifying the minimum standards necessary for regulatory oversight.

Positioning grooming within broader animal welfare policy also requires interdisciplinary collaboration between behavioural scientists, veterinary professionals, educators, and regulatory bodies. Such work would help ensure that future legislation is scientifically grounded, ethically robust, and responsive to the lived experiences of dogs and their caregivers.

Ultimately, the evidence presented here underscores the urgent need for a more scientifically informed, emotionally literate, and ethically grounded approach to grooming, marking an important step toward systemic change in companion-animal welfare.

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Annexes

Annex A. Owner Consent Form

Template used to obtain informed consent for HRV monitoring and behavioural observation.

Annex B. Owner Questionnaire Template

Trauma history, grooming frequency, and behavioural concerns.

Annex C. Ethics Standards Framework & Bias Statement

Summary of ethical safeguards and non-invasive protocols.

Annex D. CASRI Behavioural / Autonomic Marker Table

Behavioural coding sheet for autonomic stress responses.

Annex E. Grooming Stress Index (GSI)

Scoring rubric integrating HRV and behavioural data.

Annex F. Sample HRV Data Sheet

Annotated example of HRV readings across grooming phases.

Annex G. Equipment and Sensory Load Summary

Documentation of grooming tools and environmental variables.

Annex H. Owner Instructions and Participation Guide

Step-by-step guide for HRV fitting and behavioural observation.

Annex I. Sample Listing and RMSSD Scores

Raw HRV data for 46 dogs, copy presented from PDF format.

J. Refinement to Behavioural Scoring system

Proposed refinements to the behavioural scoring system that would strengthen accuracy and consistency in future research applications.

Annex A: Owner Consent Form

This annex provides the standardised owner consent form used throughout the study. It reflects the project's commitment to ethical transparency, trauma-informed principles, and respectful collaboration with dog owners. The form was designed to be clear, accessible, and reassuring, ensuring that owners felt informed and empowered throughout their participation.

OWNER CONSENT FORM FOR PARTICIPATION IN GROOMING-BASED WELFARE STUDY

Study Title: Understanding Canine Stress Responses in Grooming Contexts: A Welfare-Led Observational Study

Researcher: Dean Hart, Behavioural Biologist and PhD Candidate in Clinical Psychology

Purpose of the Study

This study aims to explore canine behavioural and physiological responses to grooming environments, with a focus on welfare indicators and trauma-informed care. Data collected will contribute to improving grooming practices and promoting emotional wellbeing in companion animals.

What Participation Involves, as a participating owner, you agree to:

- Allow your dog to be observed during routine grooming sessions with your usual dog groomer.
- Complete a brief pre-grooming behavioural assessment form
- Provide baseline heart rate variability (HRV) readings during habituation
- Permit anonymised data to be used in academic publications and educational materials

Confidentiality and Data Protection

All data will be anonymised. No identifying information about you or your dog will be published. Data will be stored securely and used solely for research and educational purposes.

Voluntary Participation

Participation is entirely voluntary. You may withdraw at any time without consequence. Your decision will not affect any services or support offered.

Consent Declaration

I have read and understood the information above. I consent to participate in this study and allow my dog's anonymised data to be used for research purposes.

Owner Name: ______________________ **Dog's Name:**

Signature: **Date:**

Thank You Very Much,
Woof, Woof.

Annex B: Owner Questionnaire

This questionnaire was designed for conversational interview with the researcher rather than completed independently by the owner. This allowed for deeper exploration of each dog's behavioural history, grooming experiences, and emotional context, often revealing subtleties that might otherwise be missed. However, it also introduces a variable: the presence and style of the researcher may influence owner responses, either through perceived expectations or subtle framing effects. Should another researcher conduct the interview, or should the owner complete the form alone the data collected may differ in tone, depth, or emphasis. This variability is acknowledged as a potential source of interpretive bias and is addressed further in Chapter 7, (7.1 Methodological Constraints and Ethical Considerations).

Owner Questionnaire: Pre-Grooming Behavioural and Contextual Assessment Form
Annex A – Owner-Completed Form
Dog's Name: ________________________________ Breed (Type or mix): ____________________________ Age: ____________ Sex: ☐ Male ☐ Female ☐ Neutered/Spayed: Yes or No Date of Grooming Session: _
Section 1: Behavioural Observations Please tick any behaviours observed, especially in the 24 hours prior to grooming: ☐ Pacing or restlessness ☐ Excessive panting (not heat-related) ☐ Hiding or avoidance ☐ Vocalising (whining, barking, growling)

☐ Clinginess or seeking reassurance ☐ Refusal to enter grooming area or transport ☐ No unusual behaviours observed
Section 2: Grooming History Has your dog been professionally groomed before? ☐ Yes ☐ No If yes, how frequently? ☐ Monthly ☐ Every 2–3 months ☐ Occasionally ☐ Only once Has your dog ever shown signs of distress during grooming? ☐ Yes ☐ No If yes, please describe briefly:
Section 3: Health and Sensory Considerations Does your dog have any known health conditions? ☐ Yes ☐ No If yes, please specify: Is your dog sensitive to any of the following? (tick all that apply & if known!) ☐ Loud sounds (e.g., clippers, dryers) ☐ Touch (e.g., paws, ears, tail) ☐ Sudden movements or restraint ☐ Specific grooming tools (please specify): ______________________ ☐ None known

Section 4: Emotional Baseline (Owner Perception)

On a scale of 1–5, how would you rate your dog's emotional state before arrival, please circle.

1 = Very anxious

2 = Slightly uneasy

3 = Neutral

4 = Calm

5 = Very relaxed

Section 5: HRV Baseline

If you have recorded a baseline HRV reading during habituation, please note:

HRV Reading (RMSSD ms): ____________________________

Date and Time of Reading: ____________________________

Conditions during reading (e.g., resting, post-walk):

Section 6: Additional Notes

Please share anything else you feel is relevant to your dog's wellbeing, grooming experience or about this research. Complete reverse if needed.

Owner signature_______________________ Name of Researcher____________________

Annex C: Ethical Standards Framework

All study materials, including behavioural data, HRV recordings, and visual illustrations were selected with ethical care and presented in accordance with welfare-led documentation standards. A personal photograph (Figure 1) was included to illustrate the concept of *Kindchenschema*. This image was selected to support discussion of morphological bias in companion animals and was presented with ethical care, ensuring clarity of purpose without emotional embellishment.

Although Selinus University does not operate a formal ethics review board, the study was guided by the following frameworks:

- EU General Data Protection Regulation (2016/679) and UK Data Protection Act (2018): Owner responses were anonymised, securely stored, and collected with informed consent. Participation was voluntary, with the right to withdraw at any time. Dog names were retained only for internal consistency; all reporting used anonymised identifiers.
- Directive 2010/63/EU on the Protection of Animals Used for Scientific Purposes: While no invasive procedures were involved, all handling protocols prioritised emotional safety, minimised stress, and respected breed-specific sensitivities.
- World Medical Association Declaration of Helsinki (2013): This declaration informed the owner consent process, ensuring transparency, autonomy, and ethical integrity.
- Trauma-Informed and Welfare-Led Principles: The study design was shaped by contemporary literature on animal trauma and emotional wellbeing (e.g., McMillan, 2019; White, 2021), with emphasis on sensory awareness, breed sensitivity, and relational ethics.

Potential Sources of Bias

While care was taken to ensure consistency and confidentiality throughout the study, it is important to acknowledge that researcher presence may have influenced owner responses. Conducting questionnaires through researcher-led conversation, rather than self-completion, facilitated richer insight into each dog's history and emotional context. However, this approach also introduces variability, as responses may shift depending on who asks the questions, how they are framed, and how comfortable the owner feels during the interaction. These relational dynamics are explored further in Chapter 7, where the influence of researcher-led engagement is considered alongside other interpretive factors.

Several additional biases may also have shaped the findings. Environmental variation between grooming settings, individual differences in dogs' health or temperament, and movement-related artefacts affecting RMSSD readings all introduce unavoidable variability in field conditions. Sampling bias is also possible, as owners who consent to participation may differ from those who decline, and highly reactive dogs may be under-represented. Finally, awareness of the study aims may have subtly influenced how groomers or owners behaved during sessions. These factors do not diminish the value of the results but highlight the complexity of capturing canine emotional states in real-world grooming environments.

Annex D: CASRI and Behavioural / Autonomic Assessment Tools

D1. The Canine Autonomic Stress Reactivity Index (CASRI) provides the scoring framework and observational markers used to assess autonomic stress reactivity in dogs during grooming sessions. CASRI supports trauma classification, HRV interpretation, and behavioural coding across Chapters 4, 5, and 7.

Overview

CASRI integrates behavioural and physiological indicators to estimate autonomic stress reactivity. Scores are derived from field observations, owner interviews, and HRV data (RMSSD), with emphasis on trauma-informed interpretation.

Scoring Range: 0–5

0 = No observable stress reactivity

5 = Severe autonomic and behavioural dysregulation

The scoring framework was developed during the research period based on field observations and trauma-informed principles. Subsequent publications (e.g., Schneider & Schwerdtfeger, 2020; Valenza et al., 2024) offer converging evidence and are cited here to contextualise and support the marker's validity.

CASRI captures two complementary domains of autonomic expression:

Passive stress responses, including freezing, flattened affect, behavioural withdrawal, gaze aversion, and reduced behavioural sequencing. These behaviours are frequently misinterpreted as calmness or compliance, yet they often reflect emotional suppression and autonomic shutdown.

Active arousal indicators, such as panting, trembling, sweating of the paws, fidgeting, and heightened startle responses. These behaviours are commonly labelled as "fidgety," "difficult," or "bad behaviour," despite representing sympathetic activation and reduced emotional regulation.

This dual-domain structure supports trauma-informed interpretation and provides a behavioural complement to physiological data collected via HRV monitoring.

Cross-Referencing

Annex A: Owner questionnaire and HRV baseline sheet

Chapter 4: Trauma classification summary table

Chapter 5: Breed-specific reactivity and equipment-related trigger

Table D1. CASRI and Behavioural/Autonomic Marker Table

CASRI Table: Observational Guide to Emotional Reactivity			
CASRI Score	**Behavioural Indicators**	**Autonomic Indicators**	**Interpretation**
0	Relaxed posture, soft eyes, normal engagement	Stable HRV, normal respiration	**No stress reactivity**
1	Mild tension, slight avoidance, brief freezing	Slight HRV dip, mild tachypnea (rapid/shallow breathing)	**Low-level reactivity**
2	Moderate avoidance, lip licking, paw lifting	HRV suppression, elevated heart rate	**Moderate stress response**
3	Sustained freezing, trembling, vocalising	HRV instability, shallow breathing	**High stress reactivity**
4	Escape attempts, defensive / offensive aggression, hypervigilance	HRV collapse, panting, autonomic spikes, salivation	**Severe reactivity**
5	Shutdown, tonic immobility, collapse	HRV flatline, bradycardia or extreme tachycardia	**Trauma-linked dysregulation**

Adapted from McMillan (2018), Schneider & Schwerdtfeger (2020), Valenza et al. (2024), and field observations.

Colour coding is used to visually represent the gradation of stress reactivity across CASRI scores. Shades progress from soft green (no or low reactivity), through orange and amber (mild to moderate reactivity), to red (severe and trauma-linked dysregulation). This visual aid supports reader interpretation without emotional framing or diagnostic implication. The table is intended as a conceptual guide to support trauma-informed observation and should be interpreted within context.

D2. Baseline HRV Recording Sheet (Habituation Phase)

This recording sheet was used by owners to collect short-duration RMSSD readings during calm, familiar contexts prior to grooming. Baseline values support interpretation of autonomic regulation by providing a reference point for each dog's typical parasympathetic activity.

Owners were asked to collect one short baseline HRV recording (3–5 minutes) on most days during the 10-day habituation period, aiming for 8–12 recordings in total. Recordings were taken when the dog was calm and settled in a familiar environment, preferably at a similar time of day, and not immediately after feeding, exercise, or notable arousal.

Owner HRV Recording Sheet (Baseline)		
Dog ID	Date	Time
Environment	Activity state	Comment
Time	RMSSD (ms)	Notes

Annex E: Grooming Stress Index

The Grooming Stress Index (GSI) is a structured observational tool designed to assess canine stress responses during grooming procedures. It complements the CASRI system by focusing on grooming-specific triggers, behaviours, and escalation patterns.

Overview

Purpose and Application

The GSI is designed to:

- support welfare-led decision-making
- highlight grooming phases associated with autonomic suppression
- contextualise behavioural shutdown within physiological patterns
- guide trauma-informed interpretation rather than diagnosis

Cross Referencing

Annex D: CASRI autonomic scoring table

Chapter 4: Breed-specific trauma classification

Chapter 5: Discussion of grooming uniform conditioning and equipment triggers

Chapter 7: Reflexivity note on handling adaptations and observer interpretation

The Grooming Stress Index (GSI) differs from the Canine Autonomic Stress Reactivity Index (CASRI) in scope and emphasis. While CASRI integrates behavioural and autonomic markers to estimate generalised stress reactivity, GSI focuses specifically on grooming-related behavioural responses, including anticipatory cues, tactile sensitivity, and context-linked avoidance. CASRI is designed to capture physiological dysregulation across settings, whereas GSI isolates stress behaviours that emerge in direct response to grooming procedures, tools, and environments. Together, these indices offer a complementary framework for trauma-informed interpretation.

Table E1. GSI and Grooming-Linked Behavioural Marker Table Adapted from field observations, trauma-informed care principles, and canine behavioural literature.

GSI Table: Behavioural Patterns Linked to Grooming Stress		
GSI Score	**Behavioural Indicators**	**Interpretation**
0	Calm engagement, relaxed posture, tolerance of handling	**No grooming-related stress**
1	Mild avoidance, flinching, brief freezing during specific tasks (e.g., paw handling)	**Low-level stress response**
2	Moderate resistance, lip licking, increased vigilance, reluctance to enter grooming area	**Moderate stress, context-linked**
3	Sustained avoidance, trembling, vocalising, hypervigilance around tools or uniform	**High stress, anticipatory and tactile triggers**
4	Escape attempts, defensive aggression, refusal to enter grooming space	**Severe behavioural reactivity**
5	Shutdown, tonic immobility, collapse, refusal to engage post-grooming	**Trauma-linked dysregulation**

As with CASRI, colour coding is used here to support visual illustration. Shades progress from green (no reactivity and low reactivity) through orange and amber (mild to moderate reactivity), to red (severe and trauma-linked dysregulation). This visual aid supports reader interpretation without emotional framing or diagnostic implication. This table is designed as a conceptual guide to support trauma-informed observation and should be interpreted in context.

Annex F: Sample HRV Sheet

Baseline and Habituation Monitoring Framework

This annex presents the structured recording sheet used to document canine Heart Rate Variability (HRV) readings across baseline and habituation phases. The sheet is designed to support trauma-informed interpretation of autonomic stress responses in relation to environmental context, activity phase, and behavioural presentation.

HRV readings are logged at multiple time points within each session, alongside autonomic and behavioural notes, to provide a multidimensional view of canine stress regulation. The inclusion of the setting (context) and phase fields allows for contextual analysis, while the time-stamped HRV log supports dynamic tracking of physiological change.

This tool complements the behavioural scoring systems outlined in Annexes D and E (CASRI and GSI), offering a physiological lens through which to interpret stress reactivity. It is intended for use in both field observations and owner-led monitoring, with emphasis on clarity, accessibility, and ethical sensitivity.

Date	Dog ID	Breed	Age	Context	Phase
Autonomic Notes					
Behavioural Notes					
HRV Log					
Time	**T**	**T**	**T**		
Reading (ms)					
Researcher name					

This sample sheet illustrates the field-based data collection process used to record RMSSD values, grooming phase context, and behavioural observations. It supports CASRI and GSI scoring and reflects the integration of physiological and behavioural data across grooming stages.

Annex G: Equipment & Sensory Load

Understanding sensory load is essential when evaluating canine welfare during grooming. Dogs, like humans, experience the world through a complex interplay of sensory inputs, including auditory, visual, tactile, olfactory, gustatory, and vestibular systems. In grooming environments, these senses are often simultaneously engaged or overstimulated, contributing to behavioural and autonomic stress responses.

Multisensory Sensitivity in Dogs

Research confirms that dogs possess heightened sensitivity across multiple sensory domains:

Auditory: Dogs detect frequencies between 67 Hz and 45,000 Hz, far exceeding human range (LSU School of Veterinary Medicine, 2024). They are particularly reactive to sudden, high-decibel sounds, which can trigger startle responses, avoidance, or shutdown behaviours.

Visual: Dogs are attuned to motion, contrast, and facial expressions. Sudden movements, flashing lights, or unfamiliar visual stimuli may act as conditioned stress triggers (Abdai et al., 2024).

Tactile: Skin and coat manipulation, restraint, and tool contact activate mechanoreceptors and nociceptors, especially in sensitive areas like paws, ears, and flanks (OpenStax Biology, 2024).

Olfactory: With over 300 million olfactory receptors, dogs are acutely aware of chemical cues. Strong disinfectants, perfumes, or unfamiliar animal scents may contribute to environmental stress (Kokocińska-Kusiak et al., 2021).

Vestibular: Elevated tables, restraint shifts, and sudden movements may disrupt balance and spatial orientation, especially in older or neurologically sensitive dogs (Gibeault, 2024).

Focus on Auditory Load: Grooming Dryers and Blasters

Among all sensory inputs, auditory load from grooming dryers and blasters is one of the most potent and under-regulated stressors. Scheifele et al. (2012) measured sound output from four commonly used forced-air dryers and found levels ranging from 94.8 to 108.0 dBA at a 1-meter distance, comparable to industrial machinery or live concerts. These levels exceed safe exposure thresholds for both dogs and groomers, with even the lowest-rated dryer requiring usage limits under 4 hours/day to avoid risk of hearing damage. Such findings underscore the need for HRV-based evaluation of equipment and support the development of welfare-led purchasing guidelines.

To contextualise the acoustic impact of grooming dryers, the following table compares their typical decibel output with familiar household appliances. This comparative framing helps illustrate how dryer noise levels may exceed everyday auditory thresholds, not only for humans, but for dogs with heightened auditory sensitivity. By aligning specific dryer models with common sound benchmarks, this table supports welfare-led equipment evaluation and highlights the need for noise-conscious grooming practices.

Table G.1: Comparative decibel ranges of household appliances and grooming dryers. Data adapted from Scheifele et al. (2012), Noise Impacts from Professional Dog Grooming Forced-Air Dryers, Noise & Health.

Item / Appliance	Decibel Range	Comparable Grooming Dryer Models
Refrigerator	50 dB	**Quieter than all grooming dryers**
Dishwasher	55–70 dB	**Comparable to Kool Dry, Wahl Pro, Simpsons Supajet**
Vacuum Cleaner	60–95 dB	**Matches Metro Commander, Shernbao, AirJet**
Hair Dryer	65–80 dB	**Similar to Wahl Pro, Kool Dry**
Garbage Disposal	75–85 dB	**Comparable to Double K, Shernbao**

Food Mixer / Processor	80–90 dB	**Matches Aeolus TD-901T, AirJet**
Blender	90–100+ dB	**Comparable to Aeolus, Double K, louder AirJet models**
Baby Crying / Squeaky pet toy	110–135 dB	**Louder than all dryers; used as stress benchmarks**

To deepen understanding of how auditory load translates into practical welfare implications, it is essential to distinguish between different types of grooming dryers. While the previous table contextualised dryer noise levels against familiar household items, the following comparison outlines the functional and sensory differences between blasters and finishing dryers. These distinctions are critical when interpreting HRV and behavioural data, as equipment choice directly influences tactile stimulation, noise exposure, and handling style — all of which contribute to a dog's stress reactivity. By mapping these features, this table supports trauma-informed decision-making and highlights the importance of equipment selection in welfare-led grooming practice.

Table G.2: Comparison of blaster and finishing dryer features relevant to canine sensory load and welfare. Data compiled from manufacturer specifications and observational field notes.

Feature	Blaster	Finishing Dryer
Air Speed	Very high (up to 60,000 ft/min)	Moderate to low; adjustable speed
gtfffffvgfPurpose	Removes excess water quickly	Used for fluff drying, styling, and finishing
Noise Level	Often loud (75–95 dB)	Quieter (60–70 dB)
Vibration	High; may cause tactile stress	Low; more tolerable for sensitive dogs
Use Case	Post-bath water removal	Final drying and coat shaping
Handling	Handheld hose; direct airflow	Stand-mounted or hands-free

Stress Risk	Higher for noise/touch-sensitive dogs	Lower; preferred for trauma-informed grooming

Focus on Visual Load: Movement, Eye Contact, and Environmental Triggers

Visual stimuli in grooming environments can significantly influence canine stress responses, particularly when shaped by prior experience. Direct eye contact during facial trimming, while necessary for precision, may be perceived by some dogs as confrontational — especially those with limited socialisation or trauma histories. The presence of other dogs, whether calm or distressed, can trigger emotional contagion or anticipatory anxiety, even without explicit associative learning.

Importantly, grooming equipment itself may become a conditioned stress stimulus. Repeated exposure to aversive grooming experiences can lead dogs to exhibit autonomic reactivity at the mere sight of tools such as electric clippers, handheld nail clippers, slicker brushes, and especially forced-air blasters. These items may elicit freeze responses, avoidance, or hypervigilance before physical contact occurs. Even static fixtures like the grooming table and bath can trigger anticipatory stress, particularly in dogs with prior negative associations.

Groomers often work under time pressure, and rapid movements — such as reaching for tools or repositioning the dog, may heighten visual alertness and sympathetic arousal. In contrast, slower, deliberate handling has been shown to support emotional regulation and reduce autonomic activation, reinforcing the importance of movement pacing and environmental awareness in trauma-informed practice.

Focus on Tactile Load: Pressure, Heat, and Equipment-Linked Discomfort

Tactile stress during grooming arises from both direct pressure and thermal exposure, often exacerbated by equipment misuse or poor maintenance. Tools such as slicker brushes, Coat Kings, Zoom groom and de-shedding blades can cause discomfort or skin trauma when applied with sustained pressure or used repeatedly in one area. Zikmann (2024) notes that canine skin is significantly thinner than human skin, averaging just 3–5 cell layers, making it highly vulnerable to friction, abrasion, and follicular damage.

Electric clippers, if not regularly serviced, may slow down and begin to drag or pull the coat, especially when working through matting close to the skin. This can result in pain, coat tearing, and increased risk of clipper burn, a common post-grooming issue linked to overheating and poor lubrication (Dog Lover's Towel, 2025). Similarly, dull scissors or Chunkers may snag or pull the coat if moved prematurely, causing discomfort and resistance behaviours.

Thermal risks also extend to bathing and drying stages. Dogs have sustained skin burns from excessively hot water, particularly when groomers fail to keep their hands in the flow to monitor temperature (WagWalking, 2025). Forced-air dryers and blasters, if poorly ventilated or overused, can overheat and cause surface burns or grazes, especially in dogs with thin coats or compromised skin integrity.

These tactile stressors underscore the importance of equipment maintenance, handling technique, and thermal awareness in trauma-informed grooming. Documenting these variables supports accurate interpretation of HRV and behavioural data and strengthens the case for welfare-led equipment standards.

Focus on Olfactory Load: Emotional Scent Cues and Environmental Triggers

Olfactory input plays a profound role in canine emotional regulation, with scent signals processed directly by the limbic system, including the amygdala and hypothalamus—regions responsible for fear, memory, and autonomic arousal. Dogs are capable of detecting hormonal changes in both humans and other animals, including elevated cortisol levels associated with stress. These scent cues, when combined with visual triggers such as restraint or unfamiliar dogs, may amplify sympathetic activation and behavioural reactivity.

Conditioned responses to grooming or veterinary procedures often include olfactory associations, where specific smells become emotionally charged through repeated exposure. The canine olfactory system is directly connected to emotional memory pathways, meaning that scents such as disinfectants, perfumes, aftershave, or grooming products may activate scent-linked memory pathways, triggering anticipatory stress before any physical contact occurs. In dogs with prior trauma or low socialisation, these cues can reinforce avoidance, hypervigilance, or shutdown behaviours (Horowitz and Franks, 2020; Dog Behavior Italy, 2025).

Notably, positive olfactory associations may also support emotional recovery. In dogs familiar with the grooming routine, the application of coat conditioner at the end of the session was observed to coincide with calming behaviours—including body softening, affiliative gestures, and reduced vigilance. This suggests that scent-linked cues, when paired with predictable and gentle handling, may contribute to post-grooming emotional regulation.

While sodium lauryl sulfate (SLS) is a common ingredient in grooming shampoos, its synthetic scent—often masked by added fragrances—may contribute to the standardised olfactory environment across salons. Though not identified as a discrete stressor, its ubiquity makes it a likely component of learned scent-based associations, particularly in dogs with prior aversive bathing experiences (4-Legger, 2025; iHeartDogs, 2025).

Dogs may exhibit anticipatory stress in grooming salons due to environmental factors including scent-based triggers (Dog Behavior Italy, 2025; Groomer to Groomer, 2024; DAATA Certification, 2025). These findings reinforce the importance of scent awareness in trauma-informed grooming and support the integration of olfactory considerations into welfare assessment frameworks.

From a CASRI perspective, olfactory triggers may influence both behavioural and autonomic scoring. Sudden avoidance, freezing, or hypervigilance in response to scent cues—especially prior to handling—may reflect conditioned emotional responses and sympathetic arousal. Documenting these reactions helps contextualise HRV data and strengthens the case for grooming practices that are guided by emotional awareness and welfare science.

Table G.3: Common Olfactory Triggers and Their Potential Impact on Canine Stress Responses

Olfactory Trigger	Source	Potential Impact on Dogs
Human stress hormones	Cortisol, adrenaline (via sweat, breath)	May trigger vigilance, avoidance, or affiliative behaviours depending on prior associations
Disinfectants and cleaning agents	Sodium Laural Sulphate phenols, strong detergents, such as Anigene	Can overwhelm olfactory system; linked to aversion, nausea, or agitation

Perfume, aftershave, scented products	Groomer's personal care items	May act as conditioned stress cues if previously associated with aversive experiences
Other dogs' scent	Residual odours from stressed or injured dogs	May trigger emotional contagion or defensive behaviours, especially in socially sensitive dogs
Grooming product residues	Shampoos (SLS) sprays, colognes	Strong or unfamiliar scents may contribute to sensory overload or avoidance
Clinical odours	Alcohol wipes, antiseptics	Often associated with veterinary procedures; may elicit anticipatory stress

These olfactory triggers, while often overlooked, form part of a broader sensory landscape that influences canine stress responses before, during, and after grooming. When considered alongside tactile, auditory, and visual inputs, they highlight the cumulative impact of environmental factors on emotional regulation and autonomic arousal. To support trauma-informed practice and accurate CASRI interpretation, the following table summarises key equipment-related variables that may contribute to sensory overload and sympathetic activation.

Table G.4: Grooming Equipment Variables Contributing to Sensory Load

Equipment	Sensory Load Type	Additional Notes
Blaster	Auditory, tactile, visual	High decibel, high air speed, strong vibration
Finishing dryer	Auditory, tactile	Lower decibel, adjustable airflow
Slicker brush (soft, medium & hard) hedgehog,	Tactile, visual	May cause discomfort in sensitive areas
Electric clippers	Auditory, tactile, visual	Often triggers anticipatory stress

Nail clippers	Tactile (pressure and vibration), visual	Associated with restraint and discomfort
Grooming table	Visual, vestibular, auditory if metal clips on tie, and if hydraulic	May trigger stress before handling begins
Bathing station	Visual, tactile, and auditory if metal	Often linked to anticipatory stress, and escape behaviour if auditory overload

Vestibular Load: Balance, Orientation, and Age-Related Vulnerability

Vestibular input governs balance, spatial orientation, and postural stability. In grooming contexts, dogs are frequently lifted, rotated, and repositioned—often on elevated platforms or slippery surfaces. These movements can challenge the vestibular system, particularly when combined with restraint or unfamiliar handling.

Older dogs are especially vulnerable to vestibular stress. Age-related changes in the inner ear, cerebellum, and proprioceptive feedback loops may reduce their ability to compensate for sudden shifts in position or unstable footing. This can result in exaggerated startle responses, freezing, or compensatory tension in the limbs and neck. In some cases, dogs may exhibit tremors, panting, or refusal to stand—behaviours that may be misinterpreted as non-compliance rather than signs of sensory overload.

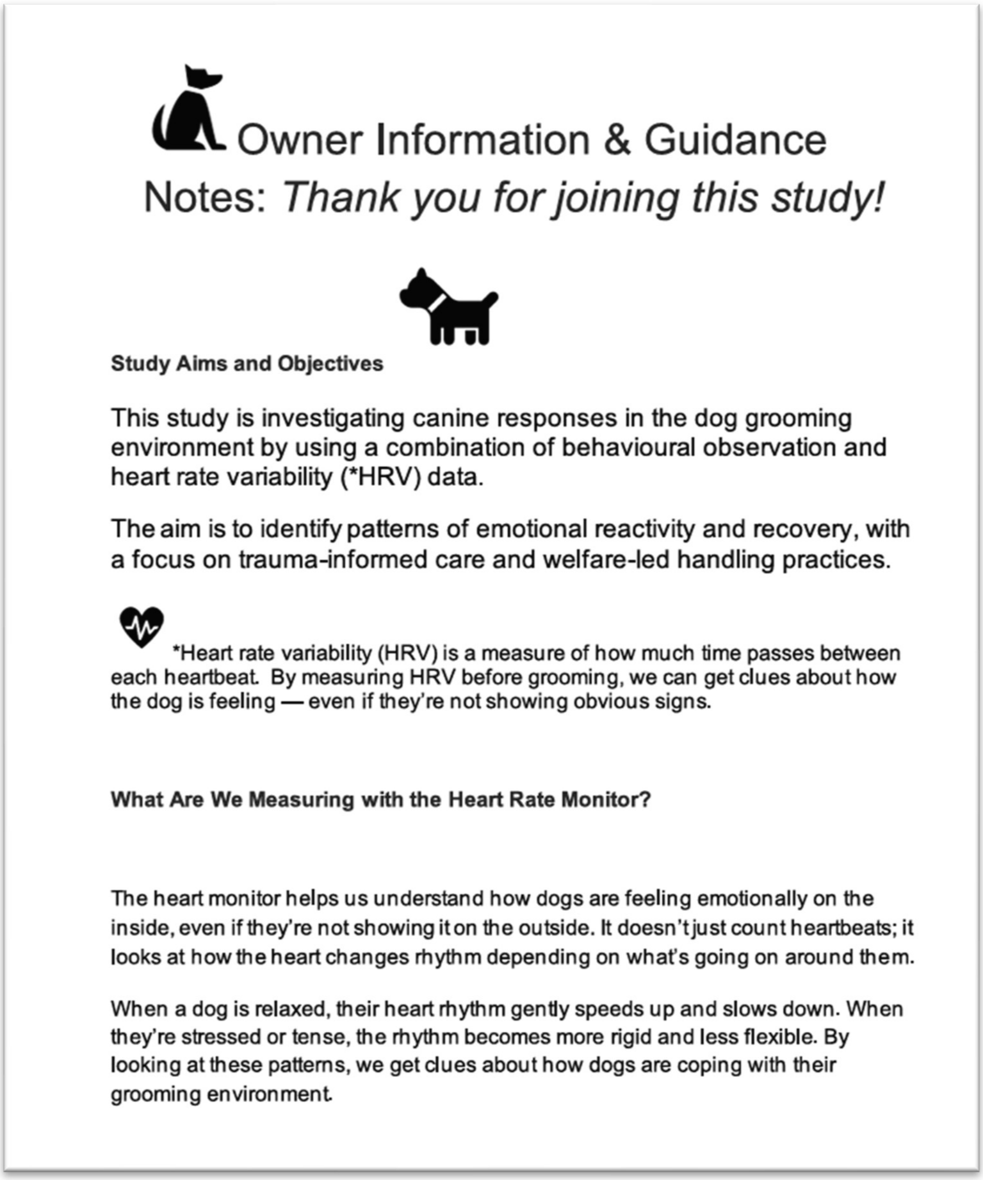
During observations older dogs consistently displayed elevated stress markers during grooming transitions, particularly when lifted or rotated without preparatory cues (again not used within the majority of grooming environments). These findings suggest that vestibular load should be considered a distinct sensory domain in welfare assessment, with implications for equipment choice, handler technique, and session pacing.

From a CASRI perspective, vestibular stress may manifest as autonomic instability (e.g., elevated heart rate, tremors) and behavioural shutdown. Documenting these responses helps differentiate age-related sensory vulnerability from temperament or training history and strengthens the case for grooming practices that are guided by emotional awareness and welfare science.

Annex H: Owner Instructions and Participation Guide

Note on App Guidance

Owners were supported in using the HRV Logger app through direct instruction and tailored guidance. A step-by-step guide was made available upon request to ensure clarity in pairing, recording, and saving data. This resource was offered outside the annex to avoid overwhelming the core instructions.



Owner Information & Guidance

Notes: *Thank you for joining this study!*

Study Aims and Objectives

This study is investigating canine responses in the dog grooming environment by using a combination of behavioural observation and heart rate variability (*HRV) data.

The aim is to identify patterns of emotional reactivity and recovery, with a focus on trauma-informed care and welfare-led handling practices.

*Heart rate variability (HRV) is a measure of how much time passes between each heartbeat. By measuring HRV before grooming, we can get clues about how the dog is feeling — even if they're not showing obvious signs.

What Are We Measuring with the Heart Rate Monitor?

The heart monitor helps us understand how dogs are feeling emotionally on the inside, even if they're not showing it on the outside. It doesn't just count heartbeats; it looks at how the heart changes rhythm depending on what's going on around them.

When a dog is relaxed, their heart rhythm gently speeds up and slows down. When they're stressed or tense, the rhythm becomes more rigid and less flexible. By looking at these patterns, we get clues about how dogs are coping with their grooming environment.

This helps us spot early signs of stress and understand which parts of the grooming process might be harder for certain dogs to cope with, especially dogs with past trauma or who are sensitive to change.

By combining behavioural observations with heart rate variability (HRV) data, we aim to better understand canine stress responses and promote welfare-led grooming practices.

Here is how your participation will help us:

- Identify early signs of stress and recovery in dogs
- Improve grooming protocols for vulnerable dogs
- Support education around welfare-led grooming

Helping Your Dog Get Used to the Heart Monitor

Before we record anything, it's important that your dog gets used to the heart monitor calmly. We're not trying to make it a fun or exciting experience — we just want it to feel ordinary. Let your dog see and sniff the strap without fuss. Put it on gently, without treats, praise, or play. The goal is to keep things quiet and neutral — not scary, but not exciting either. This helps us get a more accurate reading of how your dog is really feeling, without the monitor itself changing their mood.

Fitting the Polar H10 Heart Rate Monitor (As shown)

1. Prepare the strap: Moisten the contact pads with water or saline to help the sensor pick up the heart rhythm.

2. Connect the sensor: Snap the Polar H10 sensor into place on the strap before putting it on your dog. There's no light or screen — connection is confirmed through the app once Bluetooth pairing is successful.

3. Position the strap: Place the strap snugly around your dog's chest, just behind the front legs. The sensor should sit on the left side of the ribcage, over the heart area.

Quick Notes for Using the HRV Logger App & Recording

1. Use the mobile phone provided as it has been preloaded and set up for you to use.

Turn on Bluetooth on the HRM and make sure and make sure this phone is nearby

Connect to the Polar H10 sensor it should appear in the app's device list

Enter your dog's name to label the recording

Start recording once your dog is calm and settled

Record for 3–5 minutes during baseline and again during a relaxed event using the sheet provided

Save the session and note any behaviours you observe using the provided sheet (you will see this recording sheet has your dog's details already completed)

Annex I: Sample Listing and RMSSD Scores

This annex contains raw HRV data for 46 dogs, including RMSSD values and LF/HF ratios across seven grooming phases (P1 to P7). It supports Chapter 4 and underpins Tables 6–10 and Figures 3–9.

Annex I: Sample Listing and RMSSD Scores

A/ID	Name	A	Trauma	Breed	RMSSD	Sex	Rep	P1	P2	P3	P4	P5	P6	P7
D001	Luna	9	Low	Spaniel	27.43	F	e	1.4	1.8	2	1.5	2.3	2.6	2.1
D002	Max	3	Moderate	Cockerpoo	15	M	s	1.6	2	2.2	1.7	2.5	2.8	2.3
D003	Bella	12	Low	Retriever	47.57	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D004	Sadie	2	Moderate	Shih Tzu	19.57	F	e	1.5	1.9	2.1	1.6	2.4	2.7	2.2
D005	Oscar	10	Low	Spaniel	37.14	M	s	1.3	1.7	2	1.4	2.2	2.5	2
D006	Milly	4	Moderate	Cockerpoo	31.29	F	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D007	Ruby	7	Severe	Retriever	42	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D008	Charli	5	Low	Spaniel	22.57	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D009	Nala	8	Moderate	Labradoodle	35	F	e	1.3	1.7	2	1.4	2.2	2.5	2
D010	Rosie	2	Moderate	Chihuahua	26	F	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D011	Zoe	3	Low	Retriever	38.14	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D012	Leo	9	Low	Cockerpoo	30	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D013	Daisy	6	Moderate	Coccker Spa	44.71	F	e	1.3	1.7	2	1.4	2.2	2.5	2
D014	Toby	3	Severe	Shih Tzu	17.57	M	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D015	Coco	7	Low	Retriever	33	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D016	Rocky	2	Moderate	Cockerpoo	28.57	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D017	Lola	6	Low	Water spani	41	F	e	1.3	1.7	2	1.4	2.2	2.5	2
D018	Jack	4	Moderate	Pomeranian	20.57	M	e	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D019	Maggi	7	Low	Retriever	36	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D020	Buddy	3	Low	Cockerpoo	23.57	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D021	Dolly	4	Severe	xbreed	45	F	s	1.3	1.7	2	1.4	2.2	2.5	2
D022	Dexte	6	Moderate	Newfoundlar	16.57	M	e	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D023	Ellie	8	Low	Retriever	31	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D024	Zeus	1	Moderate	Cockerpoo	25	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D025	Eva	5	Low	GSD	39.57	F	s	1.3	1.7	2	1.4	2.2	2.5	2
D026	Riley	3	Severe	Pomeranian	21.57	M	e	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D027	Bailey	6	Low	Retriever	34	M	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D028	Chloe	2	Low	Cockerpoo	27	F	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D029	Bentle	7	Low	Spaniel	40	M	s	1.3	1.7	2	1.4	2.2	2.5	2
D030	Penny	3	Severe	Shih Tzu	18.57	F	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D031	Jaspe	6	Low	Retriever	43	M	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D032	Maya	2	Moderate	Cockerpoo	24.57	F	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D033	Winst	7	Low	Spaniel	46	M	e	1.3	1.7	2	1.4	2.2	2.5	2
D034	Murph	3	Severe	Pomeranian	28.57	M	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D035	Stella	6	Low	Retriever	36	F	e	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D036	Henry	2	Low	Cockerpoo	19.57	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D037	Izzy	8	Low	GSD	31.57	F	s	1.3	1.7	2	1.4	2.2	2.5	2
D038	Gizmc	3	Moderate	Shih Tzu	41	M	e	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D039	Rosie	7	Low	Boarder Terr	23	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D040	Tank	2	Moderate	Cockerpoo	37	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D041	Hazel	6	Low	Spaniel	15.57	F	s	1.3	1.7	2	1.4	2.2	2.5	2
D042	Moose	3	Moderate	Pomeranian	30	M	s	1.4	1.8	2.1	1.5	2.3	2.6	2.1
D043	Trixie	7	Low	Retriever	42	F	s	1.2	1.6	1.9	1.3	2.1	2.4	1.8
D044	Archie	2	Moderate	Cockerpoo	17.57	M	s	1.5	1.9	2.2	1.6	2.4	2.7	2.2
D045	Olive	6	Severe	Spaniel	35	F	s	1.3	1.7	2	1.4	2.2	2.5	2
D046	Pippa	5	Moderate	Labradoodle	29.57	F	s	1.2	1.6	2.1	1.5	2.2	2.4	1.9

Annex J: Annex J – Behavioural Scoring Refinements

This annex documents refinements made to the behavioural scoring framework following field implementation. While initial coding criteria were grounded in established ethograms and autonomic markers, real-world observations revealed patterns of ambiguity, emotional nuance, and trauma-linked variability that warranted post-hoc revision. These adjustments were guided by ethical responsiveness rather than methodological inconsistency and are discussed reflexively in Chapter 7. The revised framework aims to improve clarity, reduce observer bias, and better capture the emotional complexity of canine responses in grooming contexts.

Global Behavioural Score (1–5 Scale):	
1	Relaxed / Engaged: Soft posture, exploratory behaviour, responsive to handling, normal sequencing of behaviour
2	Mild Tension / Alertness: Slight avoidance, increased vigilance, tolerates handling with mild resistance
3	Moderate Stress / Resistance: Passive avoidance, increased resistance, vocalisation, mild distress
4	High Stress / Immobility: Fixed gaze, immobility, no resistance, HRV signs of bradycardia
5	Dissociation / Collapse: Flattened affect, complete withdrawal, shutdown, HRV collapse or freeze

Phase	**Specific Behavioural Indicators**
Arrival	Pacing, vocalisation, hypervigilance, refusal to enter, panting
Exchange of Restraint	Tense muscle, resistance, avoidance of eye contact
Bathing Start	Arched back, muscle tension, mild suppression, escape attempt, trembling, freezing, inability to carry out normal sequencing of behaviour
Blaster/Dryer	Shutdown, immobility, fixed gaze, altered HRV suppression
On Table	Anticipatory anxiety, stiff posture, scanning, increased respiration
Styling with Clippers	Vocalisation, flinching, resistance to tool proximity, escape, trembling, crouching, spinning. Non-compliance
Styling without Clippers	Passive stress, avoidance, trembling, withdrawal, non- compliance
Nail Trim	Flinching, vocalisation, resistance to feet being held, passive stress, withdrawal, escape, growl, snap, direct eye contact, fidgety

Autonomic and Postural	**Sub scores (0–2 Scale): 0 = None, 1 = Occasional / Mild 2 = Continuing/ Strong**		
	None = 0	Occasional / mild = 1	Persistent / strong = 2
Vocalisation	None: 0	In frequent = 1	Persistent: 2
Resistance to Handling	None: 0	Mild: 1	Strong: 2
Tail Position	Neutral or breed typical: 0	Lowered: 1	Tightly tucked:2

Eye Shape	Soft or almond shaped: 0	Slightly widened: 1	Wide, round or glazed: 2
Collapse Posture	Upright or sitting down: 0	Tucked limbs lying down with head up: 1	'Starfish sprawl' or tucked limbs, lying down with head down: 2
Panting:	None: 0	Occasional: 1	Persistent (non thermal): 2
Pupil Dilation	Normal as expected: 0	Slight: 1	Fully dilated: 2
Mouth Tension 0 = Relaxed, 1 = Slight draw, 2 = Tight corners	Relaxed: 0	Slight draw: 1	Tight corners: 2
Sweaty Paws: 0 = None, 1 = Moist pads, 2 = Wet prints	None: 0	Moist pads: 1	Wet prints: 2
Recovery Signs: 0 = Active engagement, 1 = Passive tolerance, 2 = No recovery	Active engagement: 0	Passive tolerance: 1	No recovery: 2