Veterinarians' perspectives of Neurology

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Abstract

Negative perspectives of neurology are commonly reported in medical education and have led to concerns regarding patient care and insufficient numbers of neurologists. Most of the proposed contributors to this "neurophobia" relate to intellectual difficulty learning and applying neurology knowledge. However, most studies to date have explored neurophobia superficially and differences between how neurophobia is defined and how it is measured challenge what the term means and our understanding of why it develops. Despite this lack of clarity, there are increasing numbers of reports that cite educational interventions to combat neurophobia. While the medical and veterinary professions share many similarities, there is very little research exploring neurophobia in veterinary medicine.

It is unclear whether negative perspectives of neurology are common in veterinarians, and what contributes to the development of veterinarians' perspectives of neurology. The overarching aims of this research were to better understand veterinarians' perspectives of neurology, how and why they develop, and the effect they can have on further learning and clinical experiences.

This research investigated veterinarians' and veterinary students' perspectives of neurology using a mixed method approach. Thematic analysis of semi-structured interviews explored how veterinarians' experiences, and their reactions to those experiences, contributed to their overall attitude towards neurology. Statistical analysis of subsequent surveys of veterinarians and undergraduate veterinary students focused on those with negative or positive attitudes towards neurology to further explore these differing perspectives. The findings of all studies were integrated to obtain a holistic understanding of how similar inciting experiences can lead to different attitudes towards neurology.

Intellectual difficulty learning and applying neurology was reported by most participants, regardless of their attitude towards neurology. Differences between participants with negative or positive attitudes towards neurology were often dictated by the individual's affective responses to that difficulty, which in turn were shaped by personality traits, values, professional identity, and the ability of the individual to resolve internal conflict. Resolution of internal conflict could improve one's attitude towards neurology. In contrast to medical literature on neurophobia, these findings suggest that an individual's attitude towards neurology is determined by the way they react to intellectual difficulty, not the difficulty itself. This distinction has implications for educational interventions for any difficult subject, not just neurology.

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Finally, I would like to dedicate this thesis to all the veterinary students and veterinarians who struggle with neurology. It is my hope that we will find ways to make you more comfortable and confident.

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1 Introduction

In the 1950's an aversion towards neurology was recognised in both medical students and doctors, resulting in (unheeded) calls to change the way in which it was taught (Poser, 1959). Thirty-five years later, Ralph Józefowicz coined the term "neurophobia", defined as "a fear of the neural sciences and clinical neurology", to describe negative perspectives he had observed in approximately half of medical students (Józefowicz 1994, p. 328). Józefowicz believed neurophobia was caused by medical students' "inability to apply their knowledge of basic sciences to clinical situations" (Józefowicz 1994, p. 328).

Subsequent research into neurophobia has revealed that negative perspectives of neurology typically persist beyond graduation, affecting approximately 40% of junior doctors (Kam et al., 2013) as well as doctors with decades of clinical experience (Schon et al., 2002). Negative perspectives of neurology also appear to be shared by medical disciplines associated with neurology, with Medina et al. (2019) classing 30% of the psychiatry residents in their study as neurophobic. Allied health professionals have also expressed negative perspectives of neurology. For example, neuroanatomy was perceived as more difficult than other anatomical systems by significantly more speech language sciences and occupational therapy students (Javaid et al., 2018). If members of other healthcare professions have negative perspectives of neurology, could veterinarians also share this tendency towards a negative perspective of neurology?

My interest in the concept of neurophobia arose from my experiences of veterinary neurology. I did not enjoy neurology as an undergraduate student; at best I was indifferent, at times I disliked it. I learnt more about neurology from my surgical supervisors during my internship than I did from my undergraduate lecturers. Although I did not love neurology when I finished that internship, I was at least more positive towards it. My attitude towards neurology only truly started to shift after I had the opportunity to see neurologists in action, and those opportunities ultimately led to me becoming a specialist in veterinary neurology. I made personal discoveries that enabled me to see that neurology actually was not that difficult and that it made sense, provided I approached it in a different way. In addition, I saw my previous negative perspectives of neurology reflected in others. While some colleagues simply voiced dislike of neurology, for others I heard panic in their voice as we discussed cases that they were unable to refer due to client constraints. When I came across the concept of neurophobia, I felt recognition.

1.1 The Importance of Understanding Neurophobia

In the medical sector, negative perspectives of neurology have been reported to manifest as paralysis of action or thinking, akin to Józefowicz's (1994) "inability to apply" theoretical knowledge in clinical situations (Abushouk & Duc, 2016; Javaid et al., 2019; Lim & Seet, 2008; Midik et al., 2017; Ridsdale et al., 2007). Paralysis in action or thinking prevents medical practitioners from appropriately examining, interpreting, and reasoning through clinical cases. This can lead to basic errors that may significantly delay diagnosis and treatment. For example, in their review of referral letters received by a neurology department, Bekkelund and Albretson (2002) reported more than half of patients referred for neurological evaluation had not had a neurological examination performed by their general practitioner. Given that a neurological examination is the most fundamental aspect of a neurological consultation and essential to determine whether a complaint is truly neurological in origin, this failure posed potentially significant risk to patient welfare and quality of life. Similar data regarding the frequency or completeness of neurological examination is not available in veterinary medicine but, as in humans, performing both neurological and general physical examinations is an essential step in the evaluation of any animal suspected of having neurological disease. In my personal experience, failure of veterinary general practitioners to perform a neurological or general physical examination when faced with a potentially neurological or stressful case appears common. Animals were frequently referred to my neurology department with a variety of non-neurological disorders that are easily identifiable on clinical examination. In some of these non-neurological cases, the delay in diagnosis and treatment through failure to perform one of the core aspects of any veterinary consultation (a general physical examination) was almost fatal.

Over recent years, concerns have been raised over decreasing neurologist numbers in the medical profession combined with an increasingly ageing population at higher risk of neurodegenerative disease, neoplasia, and stroke (Fantaneanu et al., 2014; Gutmann et al., 2019; Youssef, 2009). General practitioners' discomfort evaluating neurological cases (Morgan et al., 2007) can result in unnecessary referral of patients to an already stretched specialist discipline (Gentile et al., 2020; Wiles & Lindsay, 1996), adding to concerns over timely and appropriate patient care. Concerns for neurological patient care are as applicable to veterinary medicine as they are to human medicine. As in the medical profession, there is limited availability of specialist neurologists in veterinary medicine. Not all countries have practicing veterinary neurologists (ACVIM-Neurology or ECVN diplomates), and in those that do, financial and transportation concerns may preclude referral. Therefore, animals and their owners are frequently reliant on the capabilities of, and care provided by, veterinary general practitioners. Furthermore, there is limited availability of advanced diagnostic procedures in veterinary medicine, both due to practicalities such as access and cost, and due to veterinarians' lack of experience and discomfort in carrying out such procedures. For example, collection of cerebrospinal fluid is possible in general practice but carries potentially significant risks that may deter risk-averse veterinarians (Cook & DeNicola, 1988; Di Terlizzi & Platt, 2009).

It is possible that neurophobia amongst the veterinary profession could have a significant effect on not only patient care, but also on veterinarians' mental health. Concern over making mistakes has been reported to be a significant factor in the development of work-related stress amongst veterinarians (Bartram et al., 2009; O'Connor, 2019). Additionally, being placed in situations the veterinarian did not believe they could handle has been associated with recent veterinary graduates leaving their employment positions (Gates et al., 2020). A lack of confidence with and understanding of neurology and neurological cases could increase veterinarians' and veterinary students' stress when managing neurological cases or faced with high-stakes scenarios such as examinations.

1.2 Research Questions

Our understanding of veterinarians' perspectives of neurology is limited. At the start of my research, only a single conference abstract had evaluated a cohort of veterinary students for evidence of neurophobia (Davies & Silva-Fletcher, 2011). During the course of my research the findings of a veterinary adapted neurophobia scale were reported (Murthy et al., 2023). However, neither study evaluated veterinary perspectives of neurology in depth, nor explored underlying reasons for those perspectives.

Without knowing veterinarians' perspectives of neurology, we can only hypothesise on whether we should be concerned about neurophobia in the profession, why it does or does not develop, and what it means for our patients and profession. Our hypotheses may be wildly inaccurate; any interventions implemented based on such hypotheses would be inappropriate. Understanding how veterinarians perceive neurology and their experiences in both learning and clinical practice may suggest avenues for educational improvement, and thereby improve patient care and reduce negative mental effects when veterinarians are faced with neurological cases.

It is possible that veterinarians' perspectives of neurology mirror those of the medical profession, but the converse is also possible. Exploration of veterinarians' perspectives of neurology may provide valuable data regarding potential reasons for the development of, or for failing to develop, negative perspectives of neurology that might aid similar research in the medical profession.

The aim of this research was to explore veterinarian's perspectives of neurology to better understand not only what those perspectives are but what drives them. In particular, the research addressed the following questions:

(1) What are veterinarians' perspectives of neurology and neurological cases?
(2) What influences the development of veterinarians' perspectives of neurology?
(3) How does a veterinarian's perspectives of neurology affect that person's behaviour towards neurological cases and learning?
(4) How do a veterinarian's perspectives and experiences of neurology compare with their perspectives and experiences of other veterinary disciplines?

This research intended to provide the first step towards identifying whether, and which, educational interventions might be indicated to improve veterinarians' and veterinary students' enjoyment of and comfort with neurology.

To answer my research questions, I employed a serial mixed method approach, comprising of three phases. These phases allowed me to explore veterinarians' perspectives of neurology in an in-depth manner, from a critical realist stance. Through interviews, I was able to gain insight into a complex web of possible contributors to, and outcomes of, veterinarians' perspectives of neurology. These findings were further explored through surveys of veterinarians and of veterinary students to evaluate whether the identified possible contributors to, and outcomes of, veterinarians' perspectives of neurology were expressed within a wider veterinary population. Additionally, the surveys provided a greater understanding of the prevalence of different perspectives of neurology amongst veterinarians and veterinary students.

1.3 Structure of the Thesis

This thesis comprises eight chapters, including this one. In Chapter 2, I systematically review the medical literature regarding the concept of neurophobia, including its proposed antecedents, attributes, and outcomes. I then discuss how the limitations of that literature risks misinterpretation of reported data. The chapter concludes with discussion of the need for a clearer understanding of what neurophobia is, why it develops, and the effects it can have.

The research design is outlined in Chapter 3. In this chapter I outline my research perspective and approach, the setting for the research, and discuss threats to the validity of the research conclusions and how I have minimised these. I also present the ethical considerations that arose during development of the research and the steps taken to minimise these. The methods used in each phase of the research are briefly discussed in this chapter; more detail is provided in subsequent chapters alongside the results of each phase of the research to aid understanding of the research conclusions for that phase.

Chapters 4, 5 and 6 present the methods and results of each of the three phases of the research. Chapter 4 details my interviews with veterinarians and my thematic interpretations of contributors to their perspectives of neurology (Phase 1). Chapter 5 details the survey of veterinarians (Phase 2), based on findings from the interviews. In this chapter, the results are presented and then interpreted through an analytical lens seated in the exploration of deep rather than superficial reasons for differing perspectives of neurology. Chapter 6 details the survey of veterinary students (Phase 3), again based on findings from the interviews. Its findings are also interpreted through exploration of deeper contributors to differing perspectives of neurology.

Chapter 7 discusses the development of a model that incorporates the three phases of the research and links findings to present a more holistic understanding of contributors to veterinary perspectives of neurology. Chapter 8 presents the conclusions I have drawn, discusses the value of the research and the implications of my conclusions, and makes suggestions for future research.

1.4 Terminology

As my research conclusions are based on medical and educational literature and my interpretations of my qualitative data, some terminology used in this thesis warrants clarification. In Chapter 2 the concept of neurophobia is explored systematically through evaluation of the base elements of antecedents, attributes, and outcomes. In this thesis, antecedents are factors that contribute to the development of differing perspectives of neurology, including neurophobia. Examples of antecedents include learning experiences (undergraduate and after graduation), clinical experiences (for example, ability to investigate neurological cases, outcomes of clinical cases, and support from colleagues), personality traits, and values. Attributes are the characteristics associated with each differing perspective of neurology. Examples include affective responses when dealing with neurology or neurological cases, such as enjoyment or anxiety, and intellectual properties relating to level of knowledge and difficulty. Outcomes are the effects of differing perspectives of neurology. Outcomes may be specific to an individual (e.g. promotion or impairment of learning) or have wider-reaching effects (e.g. increased workload on existing neurologists and subsequent burn-out).

In this thesis, difficulties learning or understanding neurology are referred to as *intellectual*. Some texts associate *intellectual* with a high degree of intelligence. However, *intellect* has been defined as the faculty "by which a person knows and reasons; power of thought; understanding" (Oxford English Dictionary). I chose to use *intellectual* in this manner, to encompass aspects of both knowledge and understanding. *Intellect* has also been positioned as distinct from emotion, being "the power of knowing as distinguished from the power to feel and to will" (Merriam-Webster, 2023). Survey results associated with emotional responses are termed *affective*, consistent with previous literature exploring factors arising from or influencing emotions.

In the context of this research, values can be defined as "the generally accepted or personally held judgement of what is valuable and important in life" (Oxford English Dictionary), thus referring to both morally-held standards and personal principles. While most literature seems to separate the two, the underlying tenets of morals and personal principles appear to overlap, a finding also recognised by Charles Taylor (1989) in his discussion of the determinants of identity. When introducing his topic, Taylor notes that, in addition to more classically held moral questions, our values are based on:

> "… our sense of what underlies our own dignity, or questions about what makes our lives meaningful or fulfilling. These might be classed as moral questions on some broad definition, but some are too concerned with the self-regarding, or too much a matter of our ideals, to be classed as moral issues in most people's lexicon. They concern, rather, what makes life worth living.
>
> What they have in common with moral issues, and what deserves the vague term 'spiritual', is that they all involve what I have called elsewhere 'strong evaluation', that is, they involve discriminations of right or wrong, better or worse, higher or lower, which are not rendered valid by our own desires, inclinations, or choices, but rather stand independent of these and offer standards by which they can be judged." (p.4)

As such, both morals and personal principles demonstrate standards we aspire to uphold whilst also identifying thought processes and actions we consider inappropriate or wrong. Similarly, the consequences of failing to uphold our morals and personal principles can be emotionally distressing and have long-lasting effects. Therefore, despite the traditional tendency to separate the concepts of morals and personal principles and their influences on individuals' emotions and actions, in this thesis these concepts will be discussed in tandem as contributors to an individual's values.

1.5 Summary

This chapter has introduced the importance of neurophobia and its implications for the medical profession. It has also highlighted the potential for similar implications to the veterinary profession should veterinarians' negative perspectives of neurology manifest in a comparable manner, and the need to explore veterinarians' perspectives of neurology. Four research questions were identified, focusing on understanding how veterinarians perceive neurology, how those perspectives develop, and what effects those perspectives have on veterinarians' approaches to neurological cases and learning. Some key terminology has also been discussed. The next chapter will discuss the concept of neurophobia, and the implications of our current level of understanding of neurophobia on further evaluation of the concept, in greater detail.

2 Literature Review: What is Neurophobia?

"Neurophobia" was first proposed as an educational issue couched as a scientific report on an emerging disease (Józefowicz 1994). Neurophobia captured the attention of medical educators who had seen a tendency for medical students and practitioners to view clinical neurology and its foundational sciences negatively. While it may not actually be a phobia, the term neurophobia was seized upon and propagated in medical education literature ever since.

As discussed in Chapter 1, in human medicine concerns have been raised over patient care due to decreasing neurologist numbers in combination with increased prevalence of neurological disease and high referral rates (Fantaneanu et al., 2014; Gentile et al., 2020; Gutmann et al., 2019; Wiles & Lindsay, 1996; Youssef, 2009). These concerns over potential effects on patient well-being have resulted in increased discussion of the underlying reasons for negative perspectives of neurology, and methods to address them.

Many of the previously proposed antecedents are likely shared between the medical and veterinary professions. There are similarities in neurological anatomy, terminology, diagnostic procedures, and clinical conditions between species. Additionally, there are similar traditional teaching methods, unstandardised exposure to clinical cases, and resource limitations, including time available for teaching and learning which often results in rapid delivery of large volumes of information. Given these similarities in teaching content and method, such factors may also negatively influence the perspectives of veterinary students and veterinarians. Therefore, understanding neurophobia in the medical profession may advance understanding of veterinary students' and veterinarians' perspectives of neurology, and vice versa.

2.1 The concept of neurophobia

Although it has been discussed in the medical literature for over 25 years, there has been little effort to define the concept of neurophobia beyond that originally suggested by Józefowicz (1994)—the "fear of the neural sciences and clinical neurology that is due to the students' inability to apply their knowledge of basic sciences to clinical situations". The validity of the term neurophobia is debatable, as discussed in section 2.3.1, but whether the term is appropriate or not, neurophobia seems to have become entrenched in literature. Between 1994 and April 2021, Józefowicz's seminal reference was cited 240 times (Google Scholar) although some authors provided variations on Józefowicz's definition.

Most papers on the subject use Józefowicz's definition of neurophobia, however many authors have not measured neurophobia according to this definition. Instead, neurophobia appears to have become an umbrella term for any negative perception, or combination thereof, of neurology: for example, "the severity… ranges from simple dislike or avoidance of neurology to sub-par clinical assessment of patients with a neurological complaint" (Nham, 2012).

Concerningly, many questionnaires used in evaluating the prevalence of neurophobia amongst study populations were based on the questionnaire initially created by Schon et al. (2002); for example, Ridsdale et al. (2007), Youssef (2009), Matthias et al. (2013), and Loftus et al. (2016), amongst others. However, Schon et al. (2002) did not claim their population was neurophobic, merely that there was a tendency to consider neurology a difficult discipline. Based on this key finding, their questionnaire was a measure of perceived difficulty of neurology, not fear, dislike, or avoidance of the discipline. Because many subsequent studies on neurophobia used or adapted Schon et al.'s (2002) questionnaire, it is possible that these studies evaluated perceived difficulty of neurology rather than the aversion to neurology that they claimed to be assessing. Before employing any previously used instruments to measure neurophobia, it should be clear what we consider neurophobia, and what that instrument is actually measuring.

Given the variable applications of the term neurophobia in medical literature, I performed a systematic review to evaluate the ways neurophobia has been defined and interpreted in published literature, both relating to medical education and in other contexts. I sought to highlight and critique discrepancies, commonly reported antecedents, attributes, and outcomes, and the findings of original articles. The aim was to use this information to guide my research. However, the findings could be used to help establish an appropriate and consistent definition of neurophobia that may be applied to future and past studies, allowing standardisation to advance understanding of the fundamental contributors to the mindset of neurophobia.

2.2 Systematic Review

2.2.1 Materials and methods

The online databases SCOPUS, Web of Science and Google Scholar were searched up to 1st April 2021 with no limits on start dates, using the keywords "neurophobia" or "neurophobic". All items listed in the search results were manually reviewed for a definition of neurophobia. Articles were excluded if they were written in a language other than English, if neurophobia was not referred to in the body of the text (e.g. the term was confined to the reference list), or if the full article could not be accessed (Figure 2.1). As the intention was to evaluate the perceived meaning of neurophobia in publicly available literature, peer-review was not a requirement for inclusion. To evaluate the ways the term neurophobia is used and understood, all contexts in which it was referred to were included.

For articles in which the term neurophobia was used within the text, the stated definition(s), antecedents (factors contributing to the development of neurophobia), attributes (characteristics of neurophobia) and outcomes (effects of neurophobia) were recorded. For review articles, the antecedents, attributes, and outcomes were not recorded unless they were within the same paragraph as the definition of the term neurophobia. This decision was intended to avoid misinterpretation and misrepresentation of statements that were not clearly linked to a description of neurophobia. For each article, any defining features of neurophobia that were stated citing pre-existing literature were only counted once, even if referred to multiple times.

Articles that evaluated the perspectives, including attitudes and opinions, of healthcare professionals or students towards neurology or the neurosciences (including neuroanatomy and neurophysiology) were then read in their entirety. Articles were excluded from further analysis if, despite discussion of neurophobia, there was no novel evaluation of perspectives of healthcare professionals or students (e.g. review articles, editorials, studies evaluating interventional techniques) or there was no explicit claim that neurophobia was present amongst its participants.

Thematic analysis was performed through manual identification of key words and contexts within the data. Similar key words and contexts were grouped into categories, then categories were grouped into themes based on similarities and differences between categories. Data relating to proposed defining antecedents, attributes and outcomes was evaluated for pervasiveness of themes, so to identify common beliefs, conflicting opinions, and alternate interpretations. Repeated citation of specific antecedents, attributes and outcomes has the potential to over-emphasise the relative importance of these factors and their associations with neurophobia. Therefore, in this part of the analysis the number of uses of each term was counted for all articles, whether in relation to original data or not. The method of data collection within informing studies was also recorded.

For the purposes of this analysis, all post-graduate levels of the medical profession were considered under the category of physician unless specified to be of an alternate medical field (e.g. physiotherapy, occupational therapy). If the level of training was unclear (e.g. “trainees”), the population was grouped with undergraduate-level students.

2.2.2 Results

The search terms produced 1171 initial results. Subsequently 293 duplicate results were identified and removed (Figure 2.1). Of the 887 valid results, 472 were subsequently excluded from all further analysis due to search terms only being used in the reference list (*n* = 337), the article not being in English (*n* = 98), the search result being a citation only (*n* = 30) and the article being untraceable (*n* = 7). Of the remaining 415 results, 44 were primary studies relating to neurophobia in healthcare education, that reported perspectives of healthcare professionals or students (see Appendix A, Table A.1 for the reference list). The remaining 371 articles included 342 studies or communications relating to neurophobia in medical education in which perspectives of neurology were reviewed but not explored, and 29 articles in which neurophobia was used in reference to either biomedical concepts (e.g. cell properties; eight articles) or other disciplines (21 articles) (see Table 2.1 and section 2.2.2.1).

In total, 386 articles referred to neurophobia within the context of healthcare education.

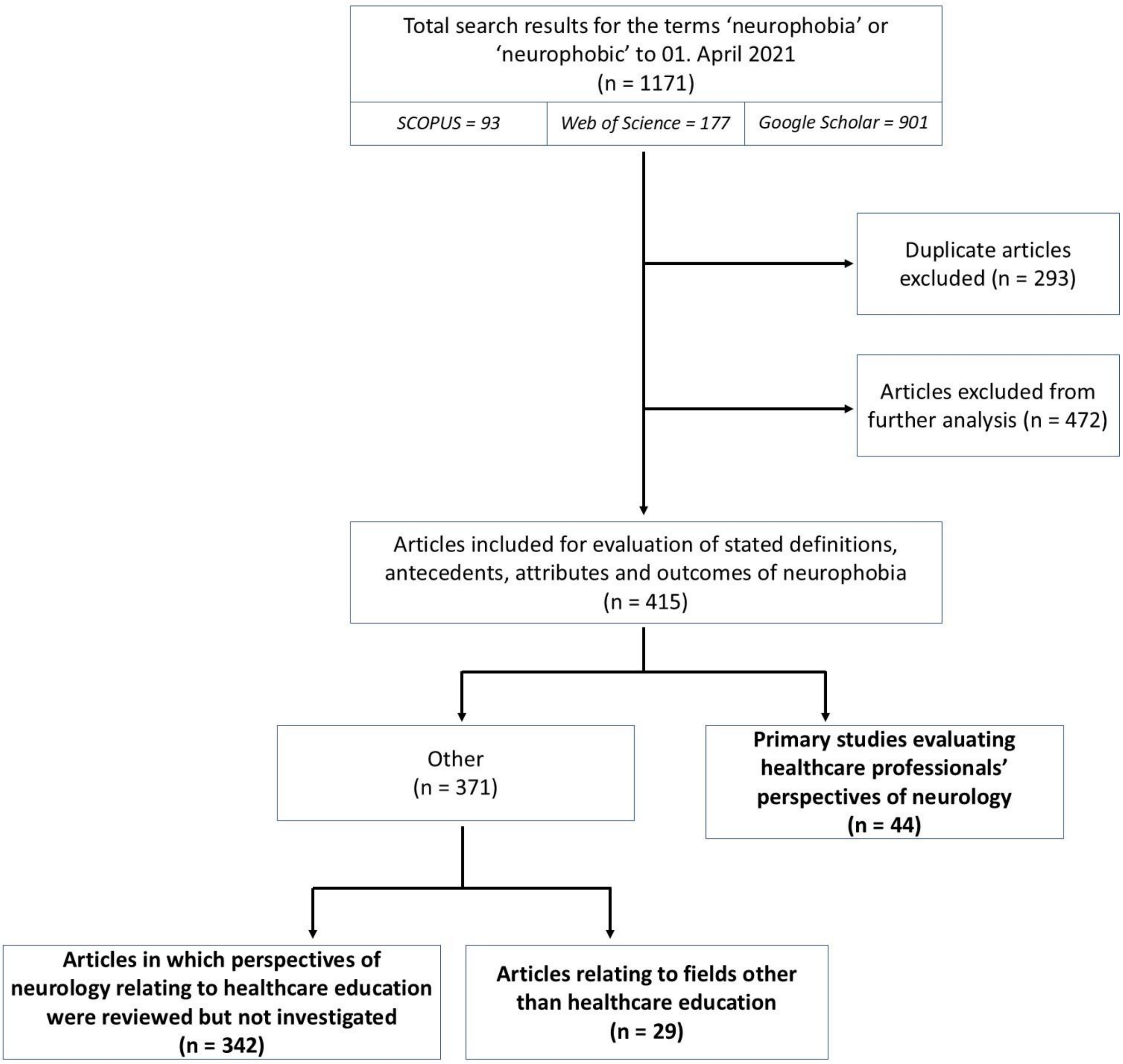

Figure 2.1 Numbers of articles excluded and included in the systemic review.

Table 2.1 Search results included for analysis of the definition of neurophobia that were not primary studies evaluating medical perspectives of neurology.

	No. search results	Total search results
Relating to medical education		342
Interventions (including abstracts)	126	
Review (including abstracts)	33	
Specific knowledge (e.g. focus on one disease)	33	
Insufficient data provided (including abstracts)	25	
Curriculum outline or recommendations (including abstracts)	27	
Opinion article	24	
Letter to journal	18	
Editorial	12	
Study guide or textbook	8	
Health sector structure	6	
Neurophilia or attractants to neurology	6	
Curriculum vitae summary (prominent neurologist)	5	
Conference proceedings or report	3	
Research proposal (uploaded)	3	
Abstract – relating to learning process	2	
Book review	2	
Powerpoint presentation (uploaded)	2	
Veterinary (specific knowledge, comment on curriculum)	2	
Case study as teaching example	1	
Examination assessment	1	
Self-assessment	1	
Tongue-in-cheek article	1	
Neurophobia in medical education but not neurology	1	
Use of “neurophobia” in a context unrelated to medical education		29
Relating to philosophy	14	
Relating to psychology or psychiatry	5	
Relating to biomedical application	8	
Relating to neuroaesthetics	1	
Relating to social sciences (unable to infer definition)	1	

2.2.2.1 Definitions of neurophobia

The definition of neurophobia was dependent on context, for example, medical education, biomedical sciences or cognitive sciences (e.g. philosophy, psychology). A definition of neurophobia was not provided or inferred in 173 of the 415 (42%) articles, suggesting the authors expected the reader to be familiar with the meaning of the term. Failure to define the term occurred in articles evaluating medical education (*n* = 161) and in alternate contexts (*n* = 12).

The definition of neurophobia in contexts other than medical education

Within the context of biomedical sciences, neurophobia was used in reference or inference to substances or cells that are repelled by or avoid neural tissue (Nassir et al., 2014; Ruardij et al., 2002a, 2002b; Rutten et al., 2007); for example, types of tumour that rarely metastasise to the brain (Raheja & Tribhuwan, 2021).

Within the cognitive sciences, neurophobia referred to an individual who disagrees with or disapproves of the explanation of abstract philosophical concepts in terms of, or through, neuroscience. A neurophobic mindset was considered unenlightened, mistrusting, and even ignorant and arrogant (Van Ommen, 2009; Zeki, 2013). This utilisation of the term neurophobia appears to have permeated the cognitive sciences context sufficiently that a definition of neurophobia was deemed unnecessary in 11 of 19 philosophy and psychology articles. In their book, Biel and Harper (2020) also failed to define neurophobia. In this text the term was used in conjunction with sexism, transphobia, and racism, suggesting it to be a form of social discrimination.

Definitions of neurophobia that did not relate to medical education were not evaluated further.

Keywords in the definition of neurophobia in the context of medical education

Most articles discussed neurophobia in the context of medical education. In medical education, neurophobia was consistently used in reference to negative perspectives towards neurology or the neurosciences, primarily amongst physicians and medical students. In total, 225 articles provided definitions of neurophobia in relation to medical education.

Evaluation of the definitions of neurophobia identified eight separate themes; six themes related to affective responses and represented perspectives, feelings, and experiences, and two themes related to properties of neurology (

Table 2.2). A further category consisted of unspecified negative perceptions, which could not be classified into a true theme. Most articles did not elaborate on underlying reasons or provide context for affective responses, limiting categorisation. In these situations, themes were maintained at a superficial level to reduce over- and misinterpretation. For these more superficial themes, possible links to other themes are noted in

Table 2.2.

Fear (fear, intimidation, or dread) was the most cited descriptor of neurophobia, included in 166 of 225 (74%) definitions relating to neurophobia in the context of medical education (

Table 2.2). Emotions consistent with lack of confidence, anxiety and aversion were noted in a further 22 of 225 (10%), 10 of 225 (4%) and nine of 225 (4%) articles, respectively. References to potential properties of neurology—perceptions of difficulty (35 of 225; 16%) and lack of knowledge (two of 225; 1%)—were less common.

Most articles associated neurophobia with either neurology as a general subject or both neurosciences and clinical neurology. Other articles focused on specific aspects of neurology. For example, 42 articles defined neurophobia as relating to clinical neurology (or a single aspect of clinical neurology), 24 defined neurophobia as relating to neurosciences (with a further seven focusing only on neuroanatomy), and nine defined neurophobia as relating to the learning process.

Many (157 of 225) articles referred to a specific population when defining neurophobia. Most of these articles (74 of 157; 47%) indicated neurophobia affected both medical students or trainees and post-graduate physicians. Other articles defined neurophobia only in relation to medical students or trainees (44 of 157; 28%), students (27 of 157; 17%), or physicians (12 of 157; 8%). No articles defined neurophobia as affecting practitioners of disciplines with neurological affiliations, despite reports of neurophobia in psychiatry residents (Medina et al., 2019) and physiotherapy students (Walker, 2013).

Table 2.2 Themes identified from definitions of neurophobia provided within medical education literature until 01. April 2021. Data were retrieved from the 225 articles referencing neurophobia in the context of medical education that provided a definition of neurophobia. Underlying causes and associations could not be explored beyond the superficial due to insufficient context; suggested links in blue represent possible deeper explanations for the described affective response.

Theme	**Theme explanation**	**Total no. of uses[a]**
Perspectives, feelings, experiences		*213*
Fear	The extreme end of the anxiety spectrum, suggesting profound negative affective reactions. Included categories: fear, intimidation, dread.	166
Lack of confidence	Low self-belief in one's ability to perform well and correctly when dealing with theoretical knowledge (e.g. during academic examinations) or its practical application (e.g. interpreting patient symptoms). Lack of confidence does not indicate lack of ability. May be linked to anxiety for some individuals. Included categories: lack of or low confidence, lack of comfort or discomfort, believed inability to work with patients.	22
Anxiety	Affective responses indicating concern over one's ability to perform well in a situation. May be linked to lack of confidence for some individuals; for others may include concern over the unknown or expected difficulty rather than a perceived inability to succeed. Included categories: anxiety, angst, apprehension, daunting	10
Aversion	The desire to avoid situations of learning or practical application of knowledge (e.g. managing patients with neurological problems). May be linked to fear, lack of confidence, anxiety, lack of motivation, or dislike. Included categories: aversion, avoidance, reluctance.	9
Lack of motivation	Unwillingness to exert the energy required to learn or apply knowledge. Included categories: uninterested, boredom, lack of enjoyment.	4
Dislike	Dislike, to varying extremes. May be linked to aversion. Included categories: dislike, revulsion	2
Properties of neurology		*37*
Difficulty	Difficulty learning, understanding, or applying knowledge. Included categories: difficulty, difficult to understand or comprehend, complicated, overwhelmed, inability to apply, unintegrated, unable to master	35
Lack of knowledge	Lack of knowledge on the subject (in both cases, this was the opinion of the authors).	2
Unspecified		*3*
Negative perception	Not specified as to what these perceptions were	3

[a]Some definitions included more than one of the above themes, resulting in 253 theme uses from 225 articles.

Numbers in italics represent subtotals relating to the theme grouping.

Operationalised definitions of neurophobia

Novel information regarding the perspectives of healthcare professionals or students towards neurology was presented in 44 studies.

In 20 of these studies, it was unknown whether participants experienced neurophobia: 19 studies did not comment whether their participants experienced neurophobia, despite nine of these studies including neurophobia in their title, and one study's phrasing made it unclear whether neurophobia was present.

In the remaining 24 studies, the presence or absence of neurophobia within the study population was clear. Neurophobia or neurology-associated anxiety was reported to be present within the study population for 22 studies, and these are discussed further below. In the other two studies (Conway & Tubridy, 2018; Nordin et al., 2018) the authors claimed neurophobia was not present, but only Nordin et al. (2018) justified their claim. Although an operationalised definition of neurophobia was not offered, Nordin et al. (2018) noted their participants had good knowledge and confidence in neurology, despite perceiving neurology to be difficult.

Of the 22 studies in which either neurophobia or neurology-associated anxiety was claimed to be present within the study population, only 15 specifically described how they determined whether a participant was neurophobic or had neuroanxiety (Table 2.3). One of these 15 studies did not provide an initial definition of neurophobia and two of the 15 studies did not include an emotion in their definition. In the remaining 12 studies neurophobia was defined as a fear, however only four of these 12 studies considered participants' expression of fear, anxiety, or aversion as indication of neurophobia or neuroanxiety (Table 3.). Medina et al. (2019) defined neurophobia as a fear of neurology and considered participants neurophobic if they self-identified as having neurophobia. However, the term was not defined in their questionnaire, and it is unknown how the term was interpreted by their participants. Ansakorpi et al. (2017) considered the expression of fear, anxiety or insecurity as indicative of neurophobia amongst their participants, despite not including these emotions in their original definition of neurophobia. With the exception of Bergden et al. (2020), who provided insufficient information in the published abstract, the remaining operationalised definitions of neurophobia focused on its previously reported attributes. Two studies (Kam et al., 2013; McGovern et al., 2021) required the combination of high perceived difficulty and low confidence, while Chua et al. (2020) considered just the perception of difficulty as indicative of neurophobia. Santos-Lobato et al. (2018) defined any negative perception of neurology as neurophobia.

Of the 15 studies that provided an operationalised definition of neurophobia or neuro-anxiety, four studies determined that neurophobia equated to the choice not to pursue a career in a neurological specialty specifically due to various negative perspectives of neurology. By excluding alternative explanations for career choice, this operational definition of neurophobia therefore inferred aversion to the discipline. Notably, although four of the 15 studies cited neurophobia as a cause of failure to pursue a career in neurology, only one of these studies included career aversion as an indicator of neurophobia amongst their population.

Table 2.3 Described methods of determining neurophobia or neuroanxiety within a study population. Data retrieved from 15 of 22 primary studies that evaluated medical professionals' perspectives of neurology and clearly indicated whether neurophobia (n = 14) or neuroanxiety (n = 1) was present in their study population. Studies reported to be primarily quantitative included at least one question where a free text option was provided. Studies reported to be primarily qualitative included at least one question where a free text response was not possible.

Approach for determining neurophobia	Article	Instrument for determining neurophobia	Written definition of neurophobia	Operationalised definition of neurophobia or neuroanxiety
Quantitative	Birkett et al. (2011)	Neuroanxiety test instrument	"Fear of neural sciences and neurology"	Use of a modified, previously validated anxiety scale to determine the presence of "neuroanxiety"
Quantitative	Gupta et al. (2013)	Survey (no detail of instrument)	The "perception that neurology is a difficult and complicated subject to understand"	An affirmative response to "neurology is difficult and hard to understand" as a reason the individual was not interested in a career in neurology
Quantitative	Kam et al. (2013)	Likert scales	"A fear of the neural sciences and clinical neurology"	A composite score of ≤4 (indicating negative perceptions) on ratings of difficulty of neurology and confidence in dealing with neurological cases
Quantitative	Shiels et al. (2017)	Likert scale	"Fear of neurology"	An affirmative response to 'I have an aversion to neuroscience'
Quantitative	Chua et al. (2020)	Likert scales	"The fear of neural sciences and clinical neurology that originates from the students' inability to apply their basic science knowledge to clinical practice leading to paralysis of thinking or action"	A score ≥4 (difficult or very difficult) when asked "Do you think Neurology is easy or difficult?"
Quantitative	McGovern et al. (2021)	Likert scales in a neurophobia measurement scale	"A fear of neural science and clinical neurology, mostly due to an inability to apply knowledge of neural science to clinical situations"	A score of >16/30, indicating difficulty, low confidence in understanding and studying ability, difficulty applying theory to clinical practice, and perceived complexity of neurology

Approach for determining neurophobia	Article	Instrument for determining neurophobia	Written definition of neurophobia	Operationalised definition of neurophobia or neuroanxiety
Primarily quantitative[a]	Fantaneanu et al. (2014)	Likert scales	"Fear of the neural sciences and clinical neurology that is due to the students' inability to apply their knowledge of basic sciences to clinical situations"	An affirmative answer to statements regarding fear of clinical neurology, academic neurosciences, or both
Primarily quantitative	Santos-Lobato et al. (2018)	Likert scales	"Fear of neurology"	A score <2 (indicating negative perceptions) for confidence, knowledge, or interest, or >2 for difficulty (indicating the perception of difficulty)
Primarily quantitative	Medina et al. (2019)	Likert scales	"Fear of neurology, which develops from a lack of integration of basic neuroscience to clinical situations, thereby creating the perception that basic neuroscience is irrelevant and that clinical neurology is unattainably complex"	An affirmative response to identifying with "neurophobia" (not defined in survey)
Primarily qualitative	Burford et al. (2019)	Free text response to questioning	"Fear of applying knowledge of basic neurosciences to clinical situations owing to a perceived difficulty and complexity"	Citing perceived difficulty of neurosurgery as a deterrent to pursuing a career in the field equated to neurophobia
Qualitative	Walker (2013)	Interview	"Fear of the neural sciences and clinical neurology that is due to the students' inability to apply their knowledge of basic sciences to clinical situations"	Analysis of interview transcripts for references to "fear"
Qualitative	Ansakorpi (2017)	Open-ended questioning and interview	"A phenomenon where medical students are unable to apply knowledge of basic neuroscience to a clinical situation"	Analysis of written answers and transcripts for descriptions of emotions classifiable as fear, anxiety, and insecurity

Approach for determining neurophobia	Article	Instrument for determining neurophobia	Written definition of neurophobia	Operationalised definition of neurophobia or neuroanxiety
Insufficient information provided	Kamour et al. (2016)	Survey (no detail of instrument)	"Fear of the neural sciences and clinical neurology that is due to the students' inability to apply their knowledge of basic sciences to clinical situations"	Affirmative responses to perceptions of "no aptitude", "complicated" and "training is difficult" as reasons for disinterest in a brain-related career
Insufficient information provided	Burford et al. (2017)	Free text response to questioning	No definition provided	Indication of fear, being overwhelmed, difficulty and negative experiences as reasons not to pursue a career in brain-related specialties
Insufficient information provided	Bergden et al. (2020)	Neurophobia measurement scale	"Fear of neuroscience hindering one's ability to learn and apply neuroanatomy clinically"	Insufficient information provided in the abstract currently published

[a]Participants were determined neurophobic via a Likert scale-based survey. Subsequent qualitative evaluation of antecedents was performed via focus groups of participants deemed neurophobic.

2.2.2.2 Antecedents, Attributes, and Outcomes of Neurophobia

Terms such as ‘due to’, ‘caused by’, ‘from’, ‘resulting in’, ‘causing’ and ‘leading to’ were often used to describe factors associated with neurophobia. These terms allowed statements and findings to be categorised as an antecedent, attribute, or outcome of neurophobia. However, consistency with regards to antecedents and attributes was often lacking, resulting in some overlap between these descriptors.

Additionally, many studies reported attributes and outcomes as an overall proportion of their study population, failing to separate the results of participants deemed neurophobic from those who were not. Despite this failure, such attributes and outcomes were often linked to neurophobia when discussing the study findings. Because such links were made and pervading citations in future studies, these reported outcomes were included in the tables of the current review.

Antecedents of neurophobia

Antecedents of neurophobia were discussed in 138 of 386 articles related to medical education. However, potential antecedents were evaluated in only 10 of the 21 studies that both investigated the perspectives of healthcare professionals or students towards neurology or neurosciences (primary studies) and reported neurophobia within their participants.

Ten themes were identified on evaluation of reported antecedents of neurophobia (Table 2.4). None of the antecedent themes were reported in every article. Overall, difficulty with neurosciences was the most cited antecedent theme. The themes suboptimal learning conditions, difficulty understanding, and overloaded learning were also commonly cited.

Amongst the 10 primary studies that reported neurophobia within their participants, suboptimal learning conditions was the most cited antecedent theme. Overloaded learning, difficulty understanding and negative perceptions unrelated to learning were the next most cited themes. Difficulty with neurosciences was the fifth-equal most cited theme.

The frequency each antecedent was referenced tended to differ between primary studies that reported neurophobia within their participants and general articles that reviewed or discussed neurophobia without reporting its presence in the study population (Table 2.4). For example, the preconception of difficulty was referenced four times in the 10 primary studies that reported neurophobia within their participants, but it was referenced only five times in the remaining 128 articles that discussed antecedents. In comparison, difficulty with neurosciences was referenced four times in the 10 primary studies that reported neurophobia in their population, and 77 times in the remaining 128 studies evaluated. A reason for these disproportionate references was not clear.

Table 2.4 Proposed antecedents of neurophobia by theme, stratified by whether the article was a primary study that reported neurophobia in the study population (Primary) or included a review or discussion of neurophobia without reporting its presence in the study population (General). Data were from 10 primary studies and 128 general articles related to medical education published until 01. April 2021. The total number of references reflect the number of times a contributor to the theme was referenced amongst the articles, not the number of articles that referenced each theme. The frequency of references to each theme are provided to demonstrate pervasiveness in the literature. Terms and statements in italics were referenced only by primary studies claiming neurophobia was present within its population. Terms and statements in bold were referenced by both primary and general articles.

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Antecedents theme	**Theme explanation**	**Total no. of references**	
		Primary	**General**
Difficulty with neurosciences	Difficulties learning or applying neurosciences, including academic difficulty and affective difficulty associated with academic difficulty. Includes: unspecified difficulty specifically relating to learning or applying neurosciences, *complexity or level of detail, "negative experience" during learning neuroscience*	4	77
Suboptimal learning conditions	Perceived suboptimal learning conditions, including adoption of learning strategies associated with shorter knowledge retention and external factors relating to delivery of content. Includes: **poor quality teaching, insufficient teaching, type of teaching,** lack of teaching aids or models, teaching methods that encourage separation between the teacher and students, **adoption of strategic- or superficial-learning strategies**	10	61
Difficulty understanding	Difficulty understanding or applying neurological concepts, in theoretical or clinical situations. Includes: abstract nature of subject, **lack of integrated teaching**, "fragmented" teaching, lack of clinical reasoning or problem-solving teaching, inability to reason through clinical problems, **inability to or perceived difficulty in applying knowledge**, difficulty reaching a diagnosis, difficulty with the neurological exam, low spatial ability, difficulty "grasping", *lack of standardised patients with clear pathology, "feeling lost"*	6	55
Overloaded learning	Difficulties learning neurology due to the amount to be learned and remembered rather than difficulty understanding that material. Includes: volume of material, **too rapid delivery for volume**, **complexity of terminology or clinical aspects**, **large number of complex or rare disorders**, over-representation of rare disorders during teaching	8	50
Lack of confidence	Perceived absence of, or reluctance to apply, neurological knowledge and skills. Includes: lack of confidence, **insufficient exposure**, hyposkilia	2	34

Negative perceptions unrelated to learning	A negatively viewed reputation or perception of neurology, relating to how neurology is portrayed or previous personal experiences. Includes: **perceived lack of treatment options**, belief neurologists are unhappy with career choice, lack of role models, **non-neurologist teachers**, stereotype of neurologists, **negative personal experiences,** *the reputation of neurology*	5	23
Unspecified difficulty		0	13
Preconception of difficulty	The expectation that neurology or the neurosciences will be difficult to learn, prior to starting that learning. Includes: **the preconception that neurology and the neurosciences are difficult**	4	5
Insufficient knowledge	Real or perceived lack of neurological knowledge or poor retention of neurological knowledge. Includes: perceived poor knowledge, lack of retention of basic neuroanatomical knowledge, "general misunderstandings", *"neuramnesia", poor performance*	2	6
Fear	Affective responses suggestive of fear. Includes: daunting perceptions, intimidation by perceived complexity, *intimidation due to rare and complex disorders*	1	6

Attributes of neurophobia

Attributes of neurophobia were discussed in 104 of 386 articles related to medical education. However, potential attributes were evaluated in only 14 of 21 studies that both investigated the perspectives of healthcare professionals or students towards neurology or neurosciences and reported neurophobia within their participants.

Eight themes were identified on evaluation of reported attributes of neurophobia (Table 2.5). Lack of confidence, perceived difficulty, fear, and insufficient knowledge were the most commonly reported attributes. Whether the same individuals experienced one or a combination of these attributes was rarely assessed. None of the attribute themes were reported in every article.

Amongst the 14 studies that both investigated the perspectives of healthcare professionals or students towards neurology or neurosciences and reported neurophobia within their participants, perceived difficulty and lack of confidence were the most commonly cited attributes themes.

Outcomes of neurophobia

Outcomes of neurophobia were discussed in 60 of 386 articles related to medical education. However, potential outcomes were evaluated in only two of 21 studies that both investigated the perspectives of healthcare professionals or students towards neurology or neurosciences and reported neurophobia within their participants.

Four different themes were identified on evaluation of reported outcomes of neurophobia (Table 2.6). Compromised patient care was the most cited outcome of neurophobia. “Insufficient neurologists” was both the second-most cited outcome of neurophobia, and the only outcome of neurophobia reported in studies that both investigated the perspectives of healthcare professionals or students towards neurology or neurosciences and reported neurophobia within their participants.

Table 2.5 Proposed attributes of neurophobia by theme, stratified by whether the article was a primary study that reported neurophobia in the study population (Primary) or included a review or discussion of neurophobia without reporting its presence in the study population (General). Data were from 14 primary studies and 90 general articles related to medical education published until 01. April 2021. The total number of references reflect the number of times a contributor to the theme was referenced amongst the articles, not the number of articles that referenced each theme. The frequency of references to each theme are provided to demonstrate pervasiveness in the literature. Terms and statements in italics were referenced only by primary studies claiming neurophobia was present within its population. Terms and statements in bold were referenced by both primary and general articles.

Attributes theme	**Theme explanation**	**Total no. of references**	
		Primary	**General**
Lack of confidence	Perceived absence of, or reluctance to apply, neurological knowledge and skills. Includes: lack of confidence, lack of comfort, hesitant to apply knowledge, *perception of 'no aptitude', low skill, insecurity or feelings of inadequacy*	14	58
Perceived difficulty	Perceived difficulty understanding neurology or neurosciences, or affective responses associated with difficulty understanding. Includes: **difficulty,** lack of understanding, difficulty grasping the main concepts, **complicated or complexity,** *frustration, confusion*	15	37
Fear	Affective responses suggestive of fear. Includes: **fear, intimidation**, paralysis of thinking, paralysis of action	3	28
Insufficient knowledge	Real or perceived lack of neurological knowledge or poor retention of neurological knowledge. Includes: **lack of or low self-perceived knowledge**, *perception neurology is 'mystical'*	9	24
Lack of motivation	Unwillingness to exert effort to learn or understand neurology, or to pursue a career in neurology. Includes: **disinterest, boredom**, lack of motivation to learn, "impatient desire for the class [or rotation or course] to end", **perception of irrelevance**	4	17
Dislike	Dislike of neurology or the neurosciences Includes: dislike, **cynicism, and nihilism**	1	12
Anxiety	Affective responses suggestive of anxiety. Includes: **anxiety**, daunting, *apprehension*	2	10
Aversion	Prefers to avoid or undertakes actions to avoid learning neurology or dealing with neurological cases Includes: aversion, avoidance, *likely to refer common conditions*	1	7

Table 2.6 Proposed outcomes of neurophobia by theme, stratified by whether the article was a primary study that reported neurophobia in the study population (Primary) or included a review or discussion of neurophobia without reporting its presence in the study population (General). Data were from two primary studies and 58 general articles related to medical education published until 01. April 2021. The total number of references reflect the number of times a contributor to the theme was referenced amongst the articles, not the number of articles that referenced each theme. The frequency of references to each theme are provided to demonstrate pervasiveness in the literature. Terms and statements in italics were referenced only by primary studies claiming neurophobia was present within its population. No terms or statements were referenced by both primary and general articles.

Outcomes theme	**Theme explanation**	**Total no. of references**	
		Primary	**General**
Compromised patient care	Provision of suboptimal patient care. Includes: inability to perform or failure to perform a neurological examination, poor skills, delayed patient care due to increased waiting times for referral, inability to clinically apply knowledge, unspecified "clinical consequences", anatomic competence not of "safe practicing level", impact on patient satisfaction, difficulty managing patients with neurological disorders, implications on the practice of healthcare	0	34
Insufficient neurologists	Insufficient numbers of doctors pursuing a career in neurology to meet patient demand. Includes: avoidance of a career in neurology and neurology-associated disciplines, worsening of neurological healthcare or patient care due to insufficient neurologists to cope with demand, *contribution to decision not to pursue neurology as a career*	2	26
Indiscriminate or inappropriate patient referral	The tendency to preferentially refer all neurological cases, even those that should be manageable in general practice. Includes: indiscriminate or inappropriate patient referral, appear unwilling to manage neurological cases or provide advice, increased number of referrals (with potential effect on healthcare system)	0	17
Impaired learning of neurological topics	Negative effects on the individual’s ability to learn, understand, or recall neurology and the neurosciences. Includes: impact on ability to effectively learn, negative effect on learning, significantly decreased recall (of neuroanatomy), poor achievement among medical students during basic sciences	0	9

2.3 Interpretation of Previous Literature on Neurophobia

The term neurophobia is not found in the Oxford English, Merriam-Webster, or Collins English dictionaries, nor in Mosby's Dictionary of Medicine, Nursing & Health Professions. The current literature review suggests a consensus is also lacking in how neurophobia is defined in medical literature.

Etymologically, both the prefix neuro- ("of or relating to nerves or the nervous system" ("Neuro-", 2022), and suffix -phobia (added to nouns to indicate "the sense 'fear of ——', 'aversion to ——''' ("-Phobia", 2022) are well-recognised and used in a consistent manner within the English language. Therefore, although not officially recognised, the term neurophobia could be defined as fear of, or aversion to, the nerves or nervous system.

The most etymologically accurate use of neurophobia would be found in biomedical contexts, in which neurophobia referred to when substances or cells were repelled by or avoided neural tissue. When neurophobia is used within the healthcare and neuroscience disciplines, the prefix neuro- has been modified to indicate the fields of neurology (and its related specialties) and the neurosciences. More contentious is the inclusion of the suffix -phobia.

2.3.1 What constitutes -phobia?

Phobias have been defined as a fear that is "extreme or irrational" ("Phobia", 2022) and "inexplicable and illogical" ("Phobia", 2023). The suggestion that a negative perspective of neurology or the neurosciences is irrational or abnormal has been criticised (Ansakorpi et al., 2017; Fuller, 2012) given that some negative perspectives of neurology appear so common as to almost be the norm. Additionally, it is unclear how intense an individual's negative perspectives of neurology must be for them to be classified as neurophobic.

However, other subjects perceived to be complicated, such as mathematics and physics, have also been associated with phobias of learning and application of knowledge. The term neurophobia might therefore have been intended to align the umbrella term for negative perspectives of neurology with terminology used in other subjects, for example, math phobia. Like neurophobia, math phobia has been linked to negative affective responses and difficulty learning and applying the subject. It is believed that anxiety caused by mathematics is associated with poor problem-solving accuracy (Young et al., 2012), which impedes ability and academic performance, and potentially promotes negative attributions that could lead to a persistent form of learned helplessness (Ramirez et al., 2018). Anxiety amongst some individuals when faced with mathematical problems has been evidenced by physiological arousal (Faust, 1992) and activation of areas of the brain responsible for emotions such as fear when faced with a mathematical task the individual found difficult (Young et al., 2012). Other researchers have found brain activity suggesting expectation of pain or disgust when about to be faced with a mathematical problem (Lyons & Beilock, 2012). Such investigations have not been performed in relation to neurophobia. Whether these "phobias" are true phobias in every instance of the term's use is questionable, with many researchers adopting the term anxiety rather than phobia.

Consistent with the suffix -phobia, most definitions included in this current review suggest that neurophobia is considered a fear or aversion, with these terms making up 70% of the keywords used in definitions of neurophobia in medical contexts. However, while this definition of neurophobia seems widely accepted, its application is not. Within the current review there were clear discrepancies between stated definitions of neurophobia and what measurements led to an individual being categorised as neurophobic.

2.3.2 Measuring neurophobia

While keywords associated with fear were predominant in definitions of neurophobia (66% of keywords), less than half the articles reviewed considered emotional responses to neurology when categorising participants as neurophobic. Aversion was referenced much less than fear (4% of keywords), but active avoidance of the discipline was a measure of neurophobia in approximately one-third of the studies that provided operationalised definitions for neurophobia. Of all the evaluated articles on medical education, only Anderson (2012) included both the terms fear and avoidance when defining neurophobia.

Some authors' operational definition of neurophobia was solely the perception that neurology is difficult. This is problematic, as difficulty and interest are not mutually exclusive. Several studies reported a high proportion of their participants perceived neurology to be interesting, despite it generally being considered difficult (Ali et al., 2021; Ridsdale et al., 2007; Schon et al., 2002). While there is undoubtedly a difference between finding something interesting and expressing interest in pursuing it as a career, the challenge and complexity of neurological specialties and neuroanatomy has also been reported as an attractant (Albert et al., 2016; Burford et al., 2019; Gupta et al., 2013; Lukas et al., 2017; Poser, 1959; Vaou & Sader, 2019). These findings indicate that an individual's attitude towards neurology may be misrepresented when researchers and educators assume difficulty and challenge equate to negative perspectives of neurology. Correspondingly, "challenged" was considered a neutral term in Birkett and Shelton's (2011) neuroscience anxiety test. Ultimately, determining an individual to be neurophobic *solely* on their perception of the subject's difficulty may well result in the inclusion of individuals with the opposite perspective and misleading reports of prevalence.

Determining neurophobia through how participants self-categorise themselves, despite failing to define the term, risks misrepresentation. The current review has shown that the definition of neurophobia differs depending on the scientific context in which it is used. Definitions in other contexts appear to be considered well-known, based on multiple authors' choice not to explain the term. Participants could therefore answer based on an alternative definition, inappropriate to the context of medical education. Alternatively, participants unaware of these definitions might have interpreted the term literally, with the extreme nuances associated with phobia influencing their self-categorisation. Most studies included in the current review adopted quantitative methods of data collection that did not evaluate participants' reasoning or clarify their interpretation of the question. Additionally, the results from participants deemed neurophobic were often not separated from those considered not neurophobic during data analysis. Consequently, it was not possible to further assess these risks of misrepresentation.

Of greater merit are the studies in which the definition of neurophobia was twofold: including both lack intention to consider a career in neurology and the presence of at least one of the potential attributes or antecedents of neurophobia. However, there are many reasons, other than neurophobia, an individual may choose a discipline over neurology (Burford et al., 2019; Gutmann et al., 2019; Kamour et al., 2016; Vaou & Sader, 2019), and early career choices are not highly predictive of a physician's final career path (Barat et al., 2019). Willingness to diagnose and manage neurological cases may be a better measure of whether an individual is neurophobic than evaluation of intent to specialise because it avoids misrepresentation of individuals who enjoy neurology but choose another discipline. Willingness to diagnose and manage neurological cases may also be a better measure of whether patient care is compromised, an outcome of neurophobia that is of concern. The medical profession is reporting a mismatch in supply and demand for neurological referral, due to insufficient neurologists to manage indiscriminate and inappropriate patient referral and the negative effects of high workload on retention of those already in the specialty (Busis et al., 2017; Gentile et al., 2020; Nguyen et al., 2019; Wiles & Lindsay, 1996). Such a mismatch is expected to result in delayed and suboptimal patient care. Encouragement of post-graduate specialisation in a neurology-related specialty, to address this mismatch, often seemed the focus of reviewed articles. However, improving the ability and willingness of general practitioners to diagnose and manage neurological patients would also be expected to address both the concerns over patient care and the high workload of existing neurologists, in a potentially more sustainable manner.

Few studies to date have evaluated the likelihood of doctors to refer neurological cases, despite aversion to neurological cases being an oft cited characteristic of neurophobia and studies frequently discussing the effects on the healthcare system from primary care physicians' reluctance to diagnose and manage neurological cases. The findings of Midik et al. (2017) suggest that common exposure to certain conditions may increase self-rated levels of knowledge and confidence, but physicians were still reliant on neurologists to at least investigate differential diagnoses and initiate treatment. Unfortunately, the reasoning behind this decision-making process was unknown. Interestingly, participants in this study rated Parkinson's disease the third-least frequently encountered condition with the third-lowest level of knowledge. Despite this, it also ranked third lowest in likelihood of referral, and confidence in managing patients with Parkinsonism was fourth highest of the 11 conditions evaluated. This could suggest that confidence was sufficient in overriding any negative feelings associated with low knowledge and infrequent exposure.

2.3.3 The reaction to challenge

For some individuals challenge is an attractant that provides stimulation and satisfaction, while for others it promotes aversion to prevent feelings of discomfort and inadequacy. This variation in reaction to challenge is perhaps reflected in the findings of Bergden et al. (2020) who reported a negative correlation between a student's perception of neurology and their neuroanatomy *self-efficacy*. In other words, students who believed they could overcome hurdles (perceived or accurate) while learning neuroanatomy had a more positive perspective of neurology, and vice versa.

Difficulty, complexity and neuroanatomy are recurring themes in participants' explanations for their negative perceptions of neurology, but these may be superficial explanations. To understand the concept of neurophobia, it may be more important to establish the overarching emotional state that these issues feed into rather than taking these recurring themes at face value. For example, is it simply a lack of confidence (e.g. due to inexperience, a previous negative experience, or a reluctance to be wrong in the highly intellectual and high-stakes world of medicine) that inhibits an individual from applying their knowledge? To what extent does unease (e.g. through insufficient experience, fear of consequences, or self-perceived inadequacy of knowledge or ability, justified or not) cause an individual to avoid situations involving neurology?

2.3.4 Difficulties interpreting current literature

The current review highlighted that care needs to be taken when interpreting and adapting the findings of published literature. As the current review found, only 21 of the 44 articles evaluating the perspectives of healthcare professionals or students towards neurology or the neurosciences actually claimed a proportion of their participants to be neurophobic. Justification of this claim was also variably robust. For example, McGovern et al. (2021) used Schon et al.'s (2002) instrument to validate their neurophobia scale. However, Schon made no claims to the presence of neurophobia in his study population, instead evaluating whether and why neurology was considered difficult. As noted above, perception of difficulty does not necessarily equate to fear of or aversion to the discipline. Therefore, even when neurophobia was claimed to be present within a population, the concept and what was being measured was unclear.

The variation in claims of neurophobia and operationalised definitions of neurophobia limits our ability to accurately interpret and apply study data. Additionally, the current review revealed that some reported antecedents and outcomes are more common amongst studies that did not investigate the perspectives of healthcare professionals or students towards neurology or neurosciences and report neurophobia within their participants, than those that did. Differences in study designs mean it is not possible to retrospectively explore whether such data discrepancies are the result of different study populations or differences in what is being measured. However, care should be taken to avoid propagating potentially misleading data in future literature.

When analysing data relating to people's perspectives, we risk misinterpretation regardless of whether we use a qualitative or quantitative approach. Unless meaning is made explicit, qualitative analysis risks researchers interpreting participants' comments according to the researcher's personal beliefs or failing to search for alternative explanations that might equally explain a comment. Closed-ended questions used in quantitative analysis can immediately introduce bias (Nardi, 2018; Slattery et al., 2011). Both questions and possible responses are based on factors that the researcher has already deemed significant, potentially based only on their personal perspectives. In both research approaches, failing to make both questions and answers explicit may result in misinterpretation by either or both the participant and researcher.

Interpretation of any situation is dependent on context. Stripping away context to produce more traditionally scientific evaluations of perspectives and experiences has been strongly criticised (Mishler, 1979) with subsequent data considered disappointing and of questionable validity. Much of the literature evaluating neurophobia in medical education is based on data that has not considered context or has limited associated context that may not be equally shared by the researcher and participant. Even if some context is provided, individual experiences will differ, making it difficult for the researcher to understand the participant's thought processes if that context is not made explicit. Likewise, my interpretations of data and my thematic analysis in this review are shaped by context relating to my personal experiences and familiarity with the literature. Furthermore, lack of context limited my ability to explore definitions of neurophobia beyond the superficial (

Table 2.2) which risked flawed theme development.

The current review of the neurophobia literature suggests that there are not only inconsistencies in our definition of what neurophobia is, but there has been insufficient exploration of what influences the development of these negative perspectives. If we wish to address these negative perspectives, we must first develop a consistent and clear definition of what neurophobia is. As Maxwell (2004, p. 7) cautioned, “ignoring [individuals’ actual perspectives] can lead to serious distortions of causal conclusions”.

2.3.5 Towards a model for the development of differing perspectives of neurology: literature review

The quantitative nature of previous data has implied a simple cause and effect influence on the development of an individual’s perspectives of neurology. This mechanism suggests: 1) the antecedents of neurophobia relate to the difficulty of neurology and neurosciences, and difficulty learning these subjects because of suboptimal learning conditions; 2) neurophobia is associated with perceived difficulty, lack of confidence and feelings of insufficient knowledge and fear; and 3) these negative feelings lead to avoidance behaviour. This conceptual framework is depicted in Figure 2.2.

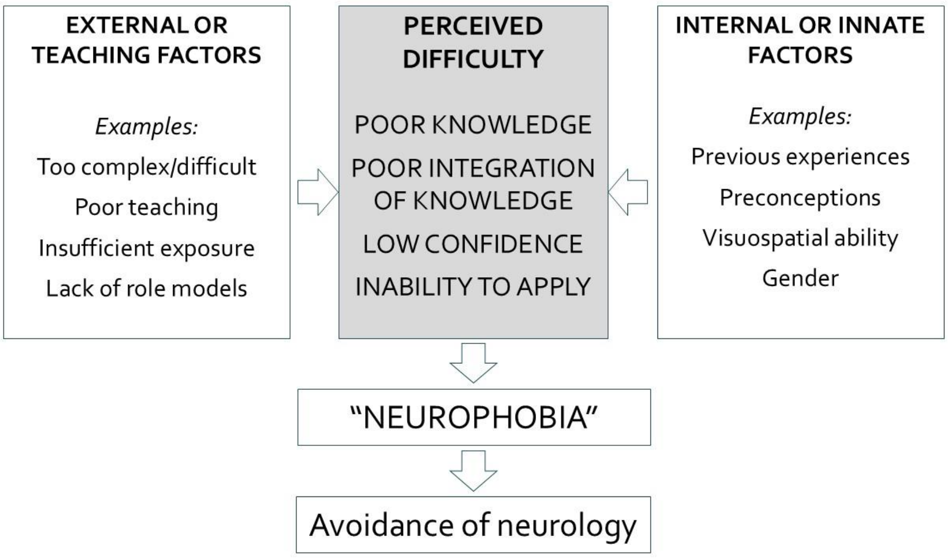

Figure 2.2 Conceptual framework for the development of neurophobia, based on review of previous medical literature. Factors within the grey box indicate summarised categories of proposed contributors to neurophobia, all factors that might contribute a perception that neurology is difficult to learn or apply.

An underlying assumption of this conceptual framework is that negative experiences of neurology trigger negative perceptions and that interventions should be focused on reducing negative experiences. Since suboptimal learning conditions and perceived difficulty of learning neurology and the neurosciences are the most frequently proposed contributors to negative neurology experiences, proposed interventions are often focused on improving teaching and learning of neurology and neuroscience.

However, such a model seems overly simplistic and based on the assumptions that the outcome of an event will lie upon a spectrum of perceived positivity, and the perceived positivity of the outcome will influence the individual's perception of the triggering event (in this scenario, an experience of neurology). Essentially, a positive outcome will lead to a positive perception of the triggering event while a negative outcome will lead to a negative perception of the triggering event.

In this basic model, changes in perspective would be possible depending on subsequent experiences of learning neurology and neurosciences. A positive shift in perspective is expected when enough experiences are perceived positively. Likewise, a shift towards a more negative perspective is expected if there are negative perceptions of multiple experiences. As perspectives develop, attitudes may change—again, becoming more positive or more negative—with the level of change dependent on the type and strength of the developing perspectives. This means that neutral or indifferent attitudes towards neurology could also be reached through positive or negative outcomes of subsequent experiences.

However, the black and white assertions demonstrated in this basic model are superficial and fail to recognise the nuances any individual will bring to a situation. How we react to a situation will be influenced by our personal values and goals, our previous experiences, and contextual factors—all of which can affect how positively or how negatively we ultimately perceive the event (Barbash, 2017). Such influencing factors should not be ignored as contributors to how an individual perceives a triggering event (Figure 2.3). Further research is therefore required to better understand the ways in which individuals' perspectives of neurology can develop.

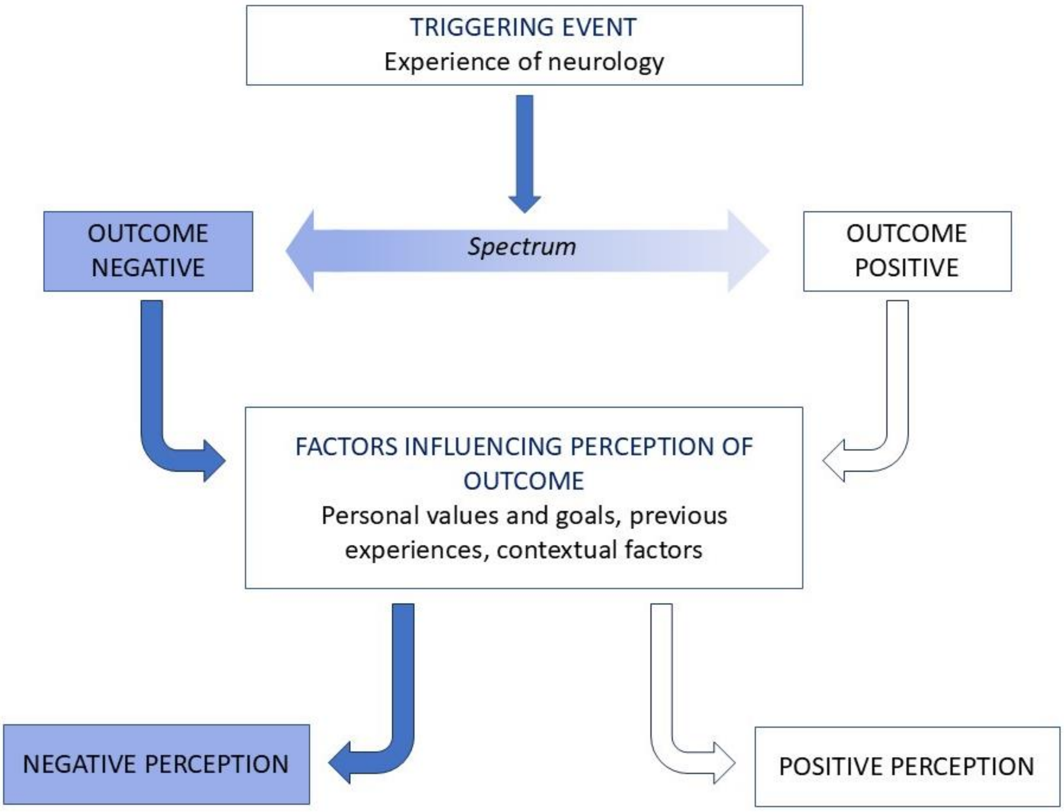

Figure 2.3 Basic assumptions made in the development of a conceptual framework for the current research, to understand how an experience of neurology might affect one's perception of that experience. A positive outcome leads to a positive perception of the experience (triggering event) while a negative outcome leads to a negative perception of the experience.

2.3.6 Strengths and limitations

Within the current review it was difficult to ascertain the relative importance authors placed on each aspect of neurophobia they discussed. For this reason, it was assumed that the components of neurophobia each author considered sufficiently relevant to mention reflected their interpretation of what neurophobia is, or what they believed the general perception of neurophobia to be. Consequently, the number of times a factor is mentioned throughout the review of the literature might also be considered a reflection of the perceived importance of that factor to the population, with factors more frequently cited perceived as more important. Furthermore, highlighting and repeating specific findings of previous studies at the expense of others could affect the reader's interpretation of the concept's definition. However, alternate explanations such as ease of access of frequently referenced articles might also explain why some factors are cited more commonly than others.

This review utilised Google Scholar as a search engine specifically to increase the number of search results that mention neurophobia. Unlike most search engines, Google Scholar identifies articles that include the search term at any point in the document, rather than only within the title, abstract or keywords. Google Scholar increased the scope of the review to include different contexts in which the term is used and provide greater insight into the perpetuation of specific aspects of neurophobia in literature.

2.4 Conclusion

This systematic literature review suggests that while similar antecedents, attributes, and outcomes of neurophobia are frequently cited, there is considerable variation in the operationalised definition of the concept and often inconsistency between the stated and operationalised definitions. There is also the tendency towards quantitative evaluation of participants' perspectives, potentially risking researcher bias and misinterpretation through insufficient clarification of questions and answers. Results of studies frequently did not separate data provided by those considered neurophobic and those who were not neurophobic, biasing any evaluation of potential antecedents, attributes, and outcomes of neurophobia. Further clarification of what neurophobia is, is required.

To improve our understanding of the issue and how best to implement educational interventions, a standardised definition should be developed that is consistent with the operational measurement of the concept. Additionally, authors should clearly state their operationalised definition of neurophobia and, when studies seek to evaluate the concept, research design should seek to minimise bias, misinterpretation, and amalgamation of results from individuals with differing perspectives of neurology.

3 Research Design

Chapter 2 showed that quantitative methods have primarily been used to explore the concept known as neurophobia. Quantitative methods are traditionally preferred when the aim of the research is to measure known contributors to a phenomenon within a population. However, our current deficiencies in understanding the concept of neurophobia and what contributes to negative perspectives of neurology, mean that we need to know if what we are measuring is appropriate. The intention of my research is to better understand the different attitudes veterinarians have towards neurology, how these attitudes developed, and what informed the development of these attitudes. The elements of my research that seek to explore veterinarians' perspectives of neurology are, therefore, best answered by qualitative methods, while evaluation of whether others share these perspectives is best accomplished through quantitative methods.

Consequently, this research was undertaken as a mixed methods study, combining qualitative and quantitative research methods and integrating the findings. To explore the perceptions, personal understanding of the discipline, the overall attitude and what factors influence these perspectives, a qualitative process with inductive analysis was performed. The second phase of the study focused on quantifying how common the views identified in the qualitative phase are within the general veterinary population. The findings of the qualitative and quantitative investigations were used to develop models that seek to explain why different perspectives of neurology develop.

This chapter will explain my theoretical perspective and its fundamental assumptions. It will also outline my methodology and methods, including the rationale for their use, and the research setting. The results of the phases of research will be integrated and discussed in the following chapters.

3.1 Research Perspective

In qualitative research, the philosophical stance and methodology embraced by the researcher are central to the research design as they govern the methods employed, and guide and limit data collection and analysis. Philosophical assumptions made by the researcher are in essence real properties inherent in the research (Maxwell & Mittapalli, 2010).

A mixed methods approach combines methodologies with potentially contradictory philosophical stances. Qualitative researchers frequently operate from an ontological stance that acknowledges the potential for multiple realities, while quantitative researchers seek to identify the one "truth". Some critics of mixed methods research, have condemned the U-turn in philosophical stance employed by some researchers when combining qualitative and quantitative methods (Denzin, 2012).

I adopted a critical realism stance in acknowledgment of the criticisms of mixed methods research, my own "hard science" background, and my observations of human cognition. Critical realism maintains the postpositivist ontological perspective that "the social world is real and independent of our knowledge of it and that it is driven by mechanisms" (Ellaway et al., 2020), although these causal mechanisms may not be immediately or always obvious (Ellaway et al., 2020; Fletcher, 2017). By recognising that mechanisms are fundamentally affected by context (Maxwell & Mittapalli, 2010), critical realism acknowledges that there are "different valid perspectives on reality" (Maxwell, 2012). However, some perspectives may be closer to reality than others (Fletcher, 2017). Each individual will interpret reality according to their personal experiences, meaning multiple but equally legitimate perspectives of reality exist. However, perspectives of reality must be sufficiently consistent with observations of the phenomenon to be considered a valid representation of reality.

By accepting individuals' perspectives as real, critical realism both recognises the validity of diverse perspectives and infers that their characteristics are measurable. This means that the causal mechanisms and factors that contribute to an individual's reality become data that may be evaluated for patterns and generalisability. Therefore, the ontological and epistemological underpinnings of critical realism enable the combination of qualitative and quantitative methodologies without contravening the fundamental philosophical stance of either.

Traditionally, research often assumes a view of causation—one variable can cause an effect on another. Quantitative research often aims to investigate whether and how reliably a specific causality manifests, while qualitative research typically seeks to understand *how* one variable may impact on another (Maxwell & Mittapalli, 2010). Critical realism considers reality to be based on networks of causal mechanisms (Fletcher, 2017); causality is not interpreted as a direct linear mechanism but rather how interactions between multiple experiences and psychosocial influences lead to the development of one's perspectives (Mingers & Standing, 2017). Because causal mechanisms are created by interactions of multiple variables, they may only be triggered in certain circumstances (Mingers & Standing, 2017) and can have causal potential even when absent (Durand & Vaara, 2009). These causal mechanisms underpin both what may be considered "actual" reality (events occur regardless of whether we experience or interpret them) and "empirical" reality (the perceived reality of events as we experience them) (Fletcher, 2017). Critical realism looks to these causal mechanisms to explain social phenomena rather than simply describing what realities result.

This focus on causal mechanisms makes critical realism a useful stance from which to pursue my goals of understanding how and why different perspectives of neurology develop. Our perspectives depend on the emotional consequences of our experiences (empirical reality). Causation may be determined by a single emotionally significant experience, or a series of experiences and the feelings they trigger. For example, first impressions are considered to be lasting. Positive first impressions can lead to greater interest and interaction in our relationships (Human et al., 2013) and this is likely true in other aspects of our lives. Initial negative impressions, however, are harder to alter than initial positive impressions, even when subsequent perspectives are more positive (Ybarra, 2001). The greater weighting on negativity means several positive experiences may be insufficient to outweigh the emotional effects of a single negative experience, resulting in an overall negative perspective. However, first impressions are not the sole determination of our perspectives. While early rewards are valued more highly than later rewards in the short-term, with time, clusters of rewards become valued, no matter when they occur (Sinclair et al., 2024). Extrapolation of such findings could explain the potential to overcome initial negative perspectives with subsequent positive experiences—provided those experiences are valued, and sufficiently positive and frequent. Exploration of causal mechanisms that contribute to perspective development helps identify not only what may affect perspectives, but how much effect they may have and to what consequence(s). Identifying common causal mechanisms or those that may have a critical effect on perspectives is essential to my research and its future application.

As causal mechanisms are subject to the social world, and therefore context-dependent, they cannot be directly identified. However, as Bhaskar (2014, p. 50) stated, “social structures do not exist apart from their effects”. Data can therefore be obtained through exploration of empirical reality, the perceived outcome of the causal mechanisms. From a theoretical standpoint people’s empirical realities are potentially infinitely different. However, our realities are usually influenced by shared sociocultural and historical experiences and knowledge. This shared understanding can help make sense of others’ perspectives, but also risks the assumption that others see the world as we do and mistakenly attributing their actions to our personal perspective. Unless we discover their actual causal mechanisms, we will invent an explanatory story that may be close to, or far from, correct. For our findings to be both valid and useful we must take care to ensure data collection processes explore the realities of others. As Maxwell (2004, p. 7) cautioned, “ignoring [individuals’ actual perspectives] can lead to serious distortions of causal conclusions”, and Becker (1996, p. 58) argued, “it is inevitably epistemologically dangerous to guess at what could be observed directly”.

Critical realism’s focus on complex networks of causation has been criticised (Durand & Vaara, 2009), with suggestions that the complexity of these networks limits our ability to differentiate active causal mechanisms from those that are not affecting the individual's perspectives. In other words, the greater the complexity of the causal mechanisms, the harder it is for us to understand the level and types of interactions between different contributing variables. However, while this may be true, it can be counter-argued that we will not achieve a greater understanding of why individuals' perspectives develop in different ways if we do not try.

With the aim of understanding how and why different perspectives develop, a phenomenographic methodology was chosen for the qualitative arm of this study. Phenomenography is the exploration of individuals' understanding of a phenomenon or concept or principle and what informs the view they adopt (Marton, 1986). By taking a second-order, experiential perspective, phenomenography aims to describe how things appear rather than what they "are", considering both what is "real" and misconceptions. Phenomenography seeks to identify and sort individuals' understandings into conceptual categories, which may in turn establish a hierarchical organisation of thought processes and views. The principles of phenomenography align with those of critical realism, taking the stance that while there is only one world, any change in the relationship between a person and the world will alter both the person and the way the world is experienced (Wright & Osman, 2018). While perceived realities may differ between individuals, they are also influenced by social constructs and the "collective intellect" that is passed between individuals, creating patterns of understanding (Marton, 1981). These patterns and hierarchical categorisation may elucidate the mechanisms by which an individual's thought process transitions from one understanding to another. While phenomenography acknowledges the constructivist epistemology that a theoretically infinite number of perceptions of a phenomenon may exist, phenomenographic research has repeatedly demonstrated that the ways of understanding the phenomenon are significantly more limited (Larsson & Holmström, 2007; Marton, 1986).

Context is an essential component of both critical realism and phenomenography given the vast potential for the interaction of experiences and perspectives, and the ability for perspectives to change (Fletcher, 2017). An experience can be viewed as the relationship between the individual and the phenomenon, incorporating aspects derived from "social, emotional, physical, historical, rational, abstract and perhaps spiritual dimensions" (Willis, 2018, p. 485). By focusing on the experiences of study participants, a researcher has the opportunity to merge both the sociocultural and psychological aspects of an individual's perspective of a phenomenon (Willis, 2018). Critical realist methods explore empirical data for tendencies rather than attempting to determine sufficient cause (that *x* will always lead to *y*). Context also minimises the risk of misinterpretation—anecdotes serve to clarify meaning (Willis, 2018) and identify discrepancies and unstated perspectives.

Phenomenography has been suggested to be useful in the exploration of learning and higher education (Wright & Osman, 2018), particularly, for identifying the conditions necessary for an individual to learn a topic. Development of understanding has been suggested to result from recognising differences between what is perceived and how it has previously been perceived (Marton & Pang, 2006). An experience and the capabilities that result are personal to the individual and specific to the context, meaning that the conditions necessary for learning are not generic. Thus, phenomenography not only complements my research goals but is also suitable for evaluating learning in educational situations. Although my research does not evaluate in detail how a course is taught or learnt, it does touch on the ways veterinarians and veterinary students learn neurology, their experiences when learning neurology, and how these factors may influence their overall perspective of the subject and resultant behaviour towards neurological cases.

3.2 Mixed Method Research Design

This thesis presents a combination of qualitative and quantitative research methods, a mixed methods approach, as it was the most appropriate way to gain understanding of the veterinary population's perspectives of neurology. Mixed methods research amalgamates the strengths of qualitative and quantitative data collection and analysis, integrating findings to reach a deeper understanding of the research question (Greene & Hall, 2010). In the current thesis, the context of veterinarians' expressed perspectives is vital, as our "view of intentions, beliefs, and meanings as causes is fundamental to our common-sense explanations of actions" (Maxwell, 2004, p. 7). Context is critical for both the subject's justification of what they think, say, or do, and the researcher's attempts to understand that person's motivations. Context has also been proposed as an important detail in the process of evaluating generalisability of findings (Maxwell, 2004) and whether specific situations are necessary to result in a particular outcome. A deeper understanding of context may therefore better enable the interpretation of quantitative, as well as qualitative, findings.

Qualitative research aims to provide in-depth data, typically necessitating small samples due to the volume of data generated. However, the small sample size can result in a narrow scope and impede the application of research findings to the wider population from which the sample was taken. The apparent limitation to the number of ways in which a phenomenon may be understood (Larsson & Holmström, 2007; Marton, 1986) supports the assumption that the mechanisms by which these understandings develop are likely to be shared by others. However, claims of generalisability are dependent on sampling strategies, including sample size (McEwan, 2020). The primarily quantitative surveys in my thesis, which were informed by my qualitative findings, allowed me to evaluate the status of the qualitative findings across a wider population and whether statistically significant relationships existed between population variables.

The phenomenographic methodology enabled the research to focus on the meaning each individual gave to the phenomenon based on their personal experience(s) and how those perceptions shaped their attitudes and actions. Many studies exploring neurophobia in medical education have evaluated potential antecedents, attributes and outcomes that were predetermined by the researchers rather than emerging from participants' perceptions. Using a mixed method approach allowed participants' experiences to guide what data was collected and explored, thereby minimising the effect of researcher bias on the quantitative phases of data collection. While the potential for researcher bias cannot be completely prevented, data were evaluated inductively in accordance with the tenets of qualitative research.

Greene et al. (1989) identified five categories of purpose when choosing mixed methods research: triangulation, complementarity, development, initiation and expansion. In the current thesis, a mixed methods design realised three of these categories of purpose. Development (the use of one method to inform the other) reduced the effect of researcher bias, and potential misrepresentation of the "truth" that can result if participants' perspectives are disregarded. Complementarity (the use of different methods to measure overlapping but different aspects of a phenomenon) was achieved as the interview and quantitative survey data highlighted areas of shared and differing understanding and attitudes between and within veterinary populations), thereby creating direction for future research and educational interventions. Finally, triangulation (evaluation for convergence)occurred as multiple methods and data sources helped determine the consistency of findings.

3.3 Methods

The mixed method design for this doctoral research consisted of three main studies conducted in sequence. The first was a qualitative study involving practising veterinarians, followed by a primarily quantitative survey of veterinarians, and finally, a primarily quantitative survey of students enrolled in a Bachelor of Veterinary Science program. The conceptual frameworks in FiguresFigure 2.2 andFigure 2.3 guided the development of the interview questions and questionnaires. A serial mixed methods design was chosen to allow interviewed participants' perspectives to also inform the development of the quantitative surveys. A schematic representation of the thesis is shown in Figure 3.1 and each study is outlined in more detail below.

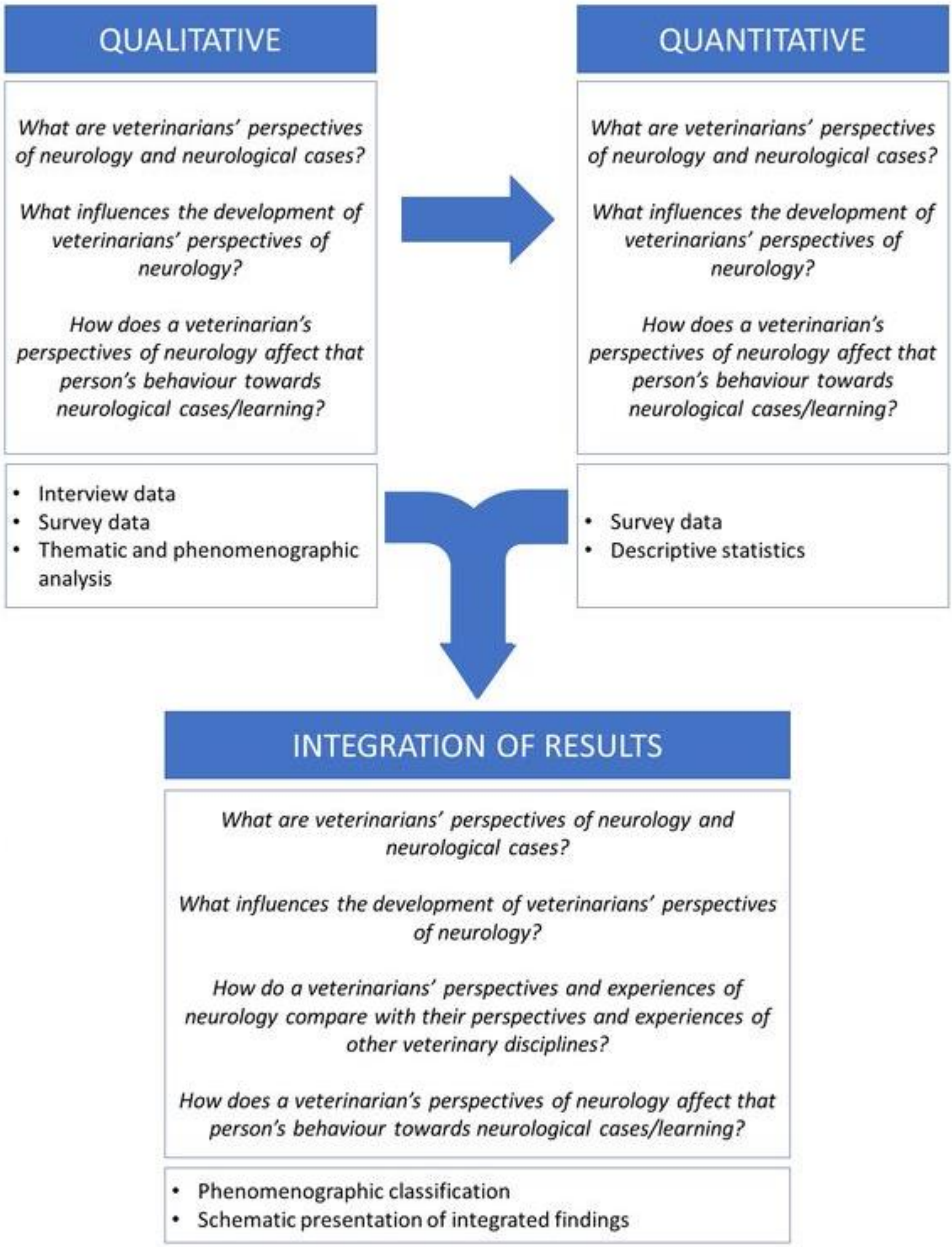

Figure 3.1 Schematic representation of the mixed methods study design employed in this research.

The setting for the qualitative study was primarily the School of Veterinary Science at Massey University, New Zealand, with additional data obtained from internationally located veterinarians, including veterinary neurology specialists (European College of Veterinary Neurology (ECVN) diploma holders), through video conferencing. The focus of the initial qualitative study was in-depth one-to-one semi-structured interviews of veterinarians with clinical experience of neurological cases. Subsequent surveys evaluated perspectives of undergraduate veterinary students and registered veterinarians in New Zealand, Australia, and the United Kingdom via online platforms.

Phenomenographic literature indicates a sample size of 20 individuals is typically appropriate to obtain "all the different ways of understanding the phenomenon" (Larsson & Holmström, 2007). Although theoretically a phenomenon may inspire an infinite number of perceptions, our understanding and creation of meaning is shaped by social influences, typically resulting in only 2–6 variations in our understanding of that phenomenon (Larsson & Holmström, 2007; Marton, 1986).

The first phase of the thesis addressed the research questions (Figure 3.1 and section 1.2) through a qualitative approach (see Chapter 4). A summary of this qualitative study is outlined in Figure 3.2. The flexibility of a semi-structured interview enabled an intentional-expressive approach (Anderberg, 2000), whereby follow-up questions were used to encourage the participant to reflect on, expand and clarify their answer. This clarification reduced the risk of misinterpreting the participant's meaning.

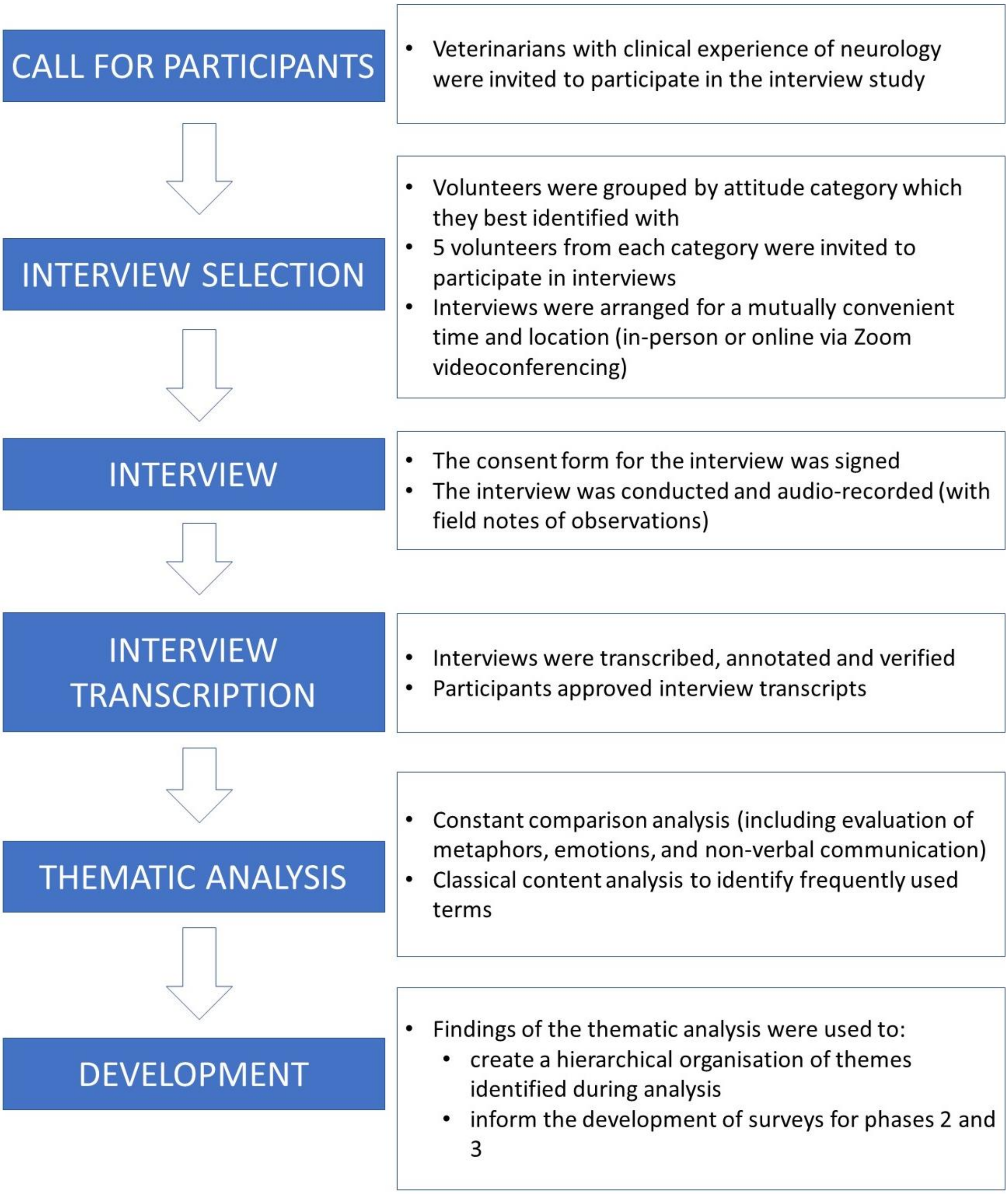

Figure 3.2 Semi-structured interviews of veterinarians explored their experiences and perspectives of neurology both in clinical practice and as undergraduates. Open questioning allowed participants to focus on the parts of the question that were relevant to their perspective (Bowden, 2000; Marton, 1986) and directed the subsequent thematic analysis towards factors that the individual considered most important, as evidenced by inflection, duration and repetition, and the order in which comments were made. Freedom of response also created an opportunity for the participant to share their perspectives, including aspects not anticipated by the researcher, and go into greater detail if they believed it appropriate.

The second and third phases of the thesis addressed the research questions through a quantitative approach (see Chapters 5 and 6). The findings of the qualitative study were used to inform these surveys. Quantitative data were collected via an online survey of veterinarians and an online survey of veterinary students. These quantitative studies sought to identify relationships between participants' attitude towards neurology and personality and experiential variables using statistical analysis.

Finally, data from all three studies were integrated to develop models that offered possible contributing factors to the development of veterinarians' and veterinary students' perspectives of neurology. Both qualitative and quantitative data were of equal importance in identifying patterns within, and influences on, veterinarian's perspectives of neurology.

Because the systematic literature review (Chapter 1) revealed the concept of neurophobia is unclear, it would have been inappropriate to limit my quantitative investigations to previously reported antecedents, attributes, and outcomes of neurophobia. An instrument has been developed to measure neurophobia in medical practitioners (McGovern et al., 2021). However, the systematic literature review in Chapter 1. identified potential flaws in the instrument's development, namely the incorporation of measures from a study that did not claim neurophobia in its participants. I determined that adapting instruments from medical education risked perpetuating inaccurate data and failed to advance understanding of neurophobia. Therefore, my research required a serial mixed methods design so that findings from the qualitative study could inform the development of quantitative survey instruments. Although the qualitative study had to be undertaken first, the quantitative surveys of veterinarians and veterinary science students were completed concurrently.

3.4 Validity of the Research

There are multiple definitions and types of validity, which creates contention regarding what validity is and how it should be measured. My research aimed to identify influences on veterinarians' perspectives of neurology at a deeper level, rather than the superficial explanations for neurophobia currently described in medical literature. Definitions in which validity is dependent on representation of participants' realities, such as that of Cresswell and Miller (2000), risked restricting my findings to the superficial. I therefore chose to consider validity according to Dellinger and Leech's (2007, p. 316) adapted definition in which validity was defined as "an overall evaluative judgment of the extent to which empirical evidence and/or theoretical rationale support the adequacy and appropriateness of interpretations and actions on the basis of data generated through any means".

Threats to the validity of the current research included researcher bias, sampling adequacy and selection bias, missing data, and response bias (e.g. linked to method effects, or social dynamics during interviews). These threats have been discussed where appropriate throughout this doctoral thesis. However, as researcher bias can have profound effects on data interpretation, this will be discussed further here.

When undertaking qualitative research, it is important to acknowledge the effect of the researcher on the findings obtained. Qualitative research is heavily reliant on interpretation, and each researcher will bring their own prior knowledge, experiences, and other potential bias. As such, "interviewer positionality and reflexivity become central to how understandings and knowledge are produced, understood, and mediated" (Manderson et al., 2006). By its very nature qualitative research is subjective—to abolish researcher bias would be incompatible with the concept of interpretation. Instead, biases should be recognised and made explicit, and at each stage of analysis the researcher should actively consider alternate interpretations of their data to avoid simply projecting their own perspectives onto others. As Bowden (2000, p. 13) noted "we have to allow that some of these meanings might not be of a kind that we would predict or even credit as being reasonable".

In this research, my veterinary background, personal experiences and awareness of the neurophobia literature all provided possible sources of bias. Here I provide some detail of these potential sources of researcher bias.

I am a veterinarian with years of experience in both general and referral level practice. My clinical experience is in companion animal practice; I have very limited practical experience of production animal, equine and exotic species sectors. I ultimately pursued specialisation in veterinary neurology, meaning that I primarily managed neurology cases over the 12 years prior to beginning the current research. My journey to becoming a specialist neurologist required achievement of a greater level of understanding of neurology and its application, as well as resilience and dedication. However, I had not initially intended to become a neurologist. I was interested in neurology but, unlike my colleagues, I did not develop a passion for it until after I began my specialisation journey. As I learned more about neurology I could both see and sympathise with the difficulties referring veterinarians experienced with neurological cases.

I wished to research veterinarians' perspectives of neurology because I have personally experienced both the negative and the positive. I have not only tried to learn neurology, but tried to teach it, encountering difficulties and frustration in both situations. As a student and as a teacher, I have encountered many of the proposed contributors to perspectives of neurology previously detailed in medical research. But while I may be able to relate to the effects these proposed contributors had on my perspectives, my reflections on my own experiences left me feeling that these proposed contributors are often superficial. Although my own experiences and understanding, and my awareness of existing literature on the subject must be construed as bias, it should also be recognised that this knowledge may be advantageous in my intention to “dig deeper”.

It is likely that my experiences of neurology, including overcoming some negative perspectives, influenced both my research method and my interpretation of data. Someone with different experiences of neurology and different perspectives would be expected to bring a different set of biases and assumptions when exploring this topic. But while it is a bias, prior knowledge of a subject provides a useful starting point for empirical research, provided it remains forefront that existing theories may not be an accurate reflection of reality (Fletcher, 2017). For this reason, findings of the systematic review and anecdotal hypotheses were not specifically evaluated during the qualitative interview study. Instead, findings were allowed to emerge from the data set rather than being purposefully sought. However, the pre-existing literature provided a set of theories to be challenged or developed by the research findings and contributed to the framework in which these findings could be positioned.

Inter-rater reliability has been suggested as a method by which rigor and trustworthiness of qualitative findings may be increased (Leech & Onwuegbuzie, 2007). Inter-rater reliability was not employed in my research. However, although I was the only person coding my data, I repeatedly questioned my interpretations; for example, when multiple interpretations of a transcript passage could exist, there were inconsistencies in my interpretations of the individual’s perceptions, understanding, or attitude, or if only interpretations consistent with my known bias were made. Additionally, I intermittently sought and discussed opinions on data interpretation and coding with my supervisors. Questioning my findings at each step of the analysis meant that reflexivity was engaged.

Triangulation, the use of corroborating evidence from different methods, is cited as a method of increasing validity of research findings (Greene et al., 1989). In triangulation, it is generally accepted that the different methods will occur simultaneously, or at least concurrently. However, sequential triangulation is also recognised as a valid approach when qualitative and quantitative phases cannot be undertaken concurrently (Morse, 1991), as in my research. In the current research, my qualitative findings were tested by the quantitative surveys they informed, with the potential for these surveys to corroborate or disprove my interpretations.

3.5 Ethical Considerations

In each phase of this research I considered the ethical implications of data collection and reporting and took steps to minimise harm. Ethical implications included: issues of informed consent; maintaining confidentiality and anonymity; risks of reputational harm; conflict of interest; and reciprocity. The qualitative study and veterinary student survey were approved by the Massey University Human Ethics Committee (SOA 21/07, SOA 22/29). The veterinary survey was determined to be of low ethical risk based on consideration of ethical implications and the university's ethics protocol, and a full ethics approval was not pursued (Ethics Notification Number 4000025698).

In each phase of the research participation was voluntary and participants had the right to decline to answer questions. Interviewed veterinarians could withdraw their consent at any point prior to data analysis. All participants were informed in writing of the research purpose and how data would be used. This information was verbally reiterated to interview participants and consent for collection of qualitative data was obtained in advance (see Appendix A, Interview consent forms for participation and transcript release). Additionally, interview participants were required to review their transcript, with the right to amend or edit any part, and provide subsequent informed written consent for data release for inclusion in the qualitative study.

All data were securely stored. All data was de-identified. Interview transcripts were assigned pseudonyms, email addresses provided by survey participants for entry into prize draws were automatically separated from data spreadsheets prior to download, and interview transcription was performed using automated computer software[1]. However, despite these measures to maintain anonymity, the potential remained for participants to be identified by comments reported verbatim, particularly in the qualitative interview study given the narrow scope of the study (as most participants were sourced from the small veterinary populations at Massey University and within the European College of Veterinary Neurology). In accordance with the Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants (revised 2017), all research should seek to avoid harm and uphold Manaakitanga (cultural and social responsibility). Therefore, non-essential details (such as, practice names, patient names, repeated sounds, and non-verbal articulations) were changed or redacted when it was suspected that such comments risked participant identification. Care was taken to ensure that changes to non-essential details did not alter the context, emphasis. or meaning of comments. All these measures were undertaken to protect anonymity.

Risk to participant reputation was considered low as a range of perspectives were evaluated in the thesis and surveys were utilised to evaluate generalisability of the perspectives, thereby normalising

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[1] NVivo Transcription, QSR International Available from: https://portal.mynvivo.com/transcription

the interview findings. Furthermore, this thesis assessed perspectives, not competency. As such, the findings do not reflect the capabilities of the participants. Similarly, risk to institutional reputation was considered low as not all interviewed and surveyed veterinarians were from a single institution, and those that were had previously worked and trained in a variety of institutions. Furthermore, the global nature of neurophobia in medical education suggested that any veterinary educational and practice-based problems identified were likely to be present in other veterinary institutions and workplaces. Risks of reputational harm were also countered by potential benefits through research output and the incorporation of research findings into suggestions to improve veterinary neurology teaching. Risks and benefits were discussed with both the Head and Deputy Head of the School of Veterinary Science, who were both supportive.

In all phases of research, the consent process must be free from coercion and clear with regards to the extent of the individual's involvement, the purpose and way their data will be used, and by whom it will be used. My research involved veterinarians, none of whom I directly worked with at the time, and undergraduate veterinary students, some of whom I had taught in the past and others I would subsequently teach. However, risks of conflict of interest were low as: 1) it was made clear that participation in the qualitative arm was voluntary; and 2) quantitative data was de-identified during collection, meaning I did not know who had participated and who had not. Undergraduate students were further reassured that neither participation/non-participation nor answers provided would have a negative impact on the individual or student body.

This research aims to establish a better understanding of the perspectives of veterinarians towards neurology and how these perspectives translate into clinical practice. Any identified areas of concern may result in subsequent development of instruments to identify students who require further assistance and educational interventions to address deficits in understanding or application of neurology. Dissemination of the findings may therefore benefit not only individuals but the veterinary profession as a whole and the patients in our care. More immediate benefits to participants included the well-being effects associated with altruism, pride in their contribution to research aiming to improve their profession, and the opportunity to enter a prize draw for a variety of vouchers.

3.6 Summary

This chapter outlined and justified the critical realist theoretical perspective and mixed methodology used to explore the research questions in this research into veterinarians' perspectives of neurology. More detailed discussion of the research methods, settings and scope are provided in subsequent chapters alongside the findings of each phase of the research. The findings of the qualitative study were central to this research because they informed the development of the quantitative studies. Therefore, the primary threat to validity in this research was researcher bias during interpretation of the qualitative data. Additional validity threats, including sampling adequacy and selection bias, missing data, and response bias, are discussed further in subsequent chapters when addressing identified strengths and limitations of each phase of the research. Ethical implications were considered at each stage of study development, with steps taken to manage issues of informed consent, maintaining confidentiality and anonymity, risks of reputational harm, conflict of interest, and reciprocity.

4 Veterinary Voices: A Qualitative Exploration of Veterinarians' Perspectives of Neurology

4.1 Introduction

The phenomenon referred to as neurophobia is widely recognised in medical literature and reported to affect both medical students and physicians in many countries (see Chapter 2). Most data on neurophobia have been obtained through administration of surveys focused on identifying intellectual difficulty and lack of confidence learning or applying the subject. There is little qualitative data exploring perspectives of neurology amongst medical students or practitioners, and even less amongst veterinarians.

This chapter addresses the gap in our understanding of veterinarians' perspectives of neurology using a qualitative approach. Individual interviews were conducted with a small group of veterinarians holding differing attitudes towards neurology to provide an initial in-depth exploration of all three research questions: determining the perspectives of and experiences of this group of veterinarians in managing neurological cases; how these compare with their perspectives and experiences of managing non-neurological cases; and exploring the social and contextual factors informing their perspectives.

The in-depth findings presented in this chapter will then inform creation of a survey tool to collect information from the veterinary profession (Chapter 5) and undergraduate veterinary students (Chapter 6).

4.2 Research Method

Data were collected via semi-structured interviews with veterinarians. The format offered veterinarians freedom to discuss their views and perspectives, with perceived relative importance expressed through inflection, duration, repetition, and the order in which comments were made. The format also provided the opportunity for me to clarify, redirect and explore answers for more detail to aid my understanding of each participant's experiences, views, and perspectives. Given my critical realist stance, clarification and exploration of participants' perspectives was critical to better understand the causal mechanisms underlying participants' attitudes towards neurology (see Chapter 3, section 3.1).

4.2.1 Interviews

The interview protocol is provided in Appendix A: Systematic Review, Interview and Survey Information. The interview consisted of seven sections: participant background, narratives of cases that were perceived positively or negatively, conceptualisation of neurology as a subject, opinions of neurology as a clinical discipline, comparison of neurology to other disciplines, additional information or perspectives, and confirmation of the participant's attitude towards neurology (see Section 4.2.3 Participants). The interview questions were informed by the conceptual framework developed from review of previous medical literature (Figure 2.2) and the basic model for understanding how perspectives of neurology developed (Figure 2.3). The interview questions therefore explored perspectives of neurology both in relation to specific contexts, such as recollections of case-based or specific learning experiences, and in general, such as overall impressions of neurology as a discipline or undergraduate learning of neurology. Participants were not asked outright about their values and goals, how their perspectives of neurology affected their behaviour towards neurological cases and learning, or how their affective responses towards neurology compared with those of other disciplines, but these topics were evaluated indirectly through discussion of the participants' experiences.

Questions relating to participant background provided baseline data only. Case narratives provided purely contextual discussion of neurology and were used to encourage participants to reflect on the events and identify and explore both explicit and subconscious causes for affective responses. Conceptualisation of neurology as a subject only evaluated overall perspectives of neurology. Separating contextual experiences from overall perspectives allowed identification of discrepancies and consistencies between answers. The remaining interview sections included a mix of contextual and overall perspective questions that delved into what the individual valued, how well experiences with neurological cases and learning neurology met these values, and the affective (emotional) responses that resulted from these experiences

Pilot interviews with two individuals demonstrated that the interview questions elicited answers appropriate to the research questions. The pilot interviews were not included in the analysis.

Most interviews lasted around 40 minutes but ranged from 22 to 68 minutes. When geographically possible, interviews were conducted in-person with each participant in their own office or a workplace meeting room. The remaining interviews were conducted using a synchronous online videoconferencing platform.[2] The combination of online and in-person interviews within a single study

[2] Zoom Video Communications, Inc. San Jose, U.S. Available from: https://zoom.us/

has previously been utilised without overt effects on data quality (Deakin & Wakefield, 2014; Jenner & Myers, 2019; Krouwel et al., 2019).

Interviews were audio-recorded with participants' permission and gestures and observations were recorded in field notes. Video recordings of online interviews were obtained automatically by the software but were not used. Audio recordings were transcribed using automated software[3],which I then checked and corrected while listening to the recordings. I added annotations to denote inflections, contrary meaning (e.g. sarcasm), and field note observations. Each transcript was verified by the participant who had the opportunity to correct or clarify any aspect of their transcript. Only minor typographical errors were identified in a few transcripts, and these were corrected. All participants confirmed their consent to analyse the data within the transcripts following this review. Pseudonyms were subsequently assigned to each participant. Both the transcripts and audio recordings were uploaded into NVivo[4] under these anonymous identifiers (see Appendix B, Table B.1). The study was approved by the Massey University Human Ethics Committee (SOA 21/07).

4.2.2 Thematic analysis

Thematic analysis was performed using NVivo. Data were analysed using constant comparison analysis; the method of choice when research questions are general or overarching (Leech & Onwuegbuzie, 2007). In this method, "chunks" of data are assigned codes, then grouped with similar codes to create themes. The codes developed through exploration of the transcript. Although codes were not predetermined some may have been influenced by the conceptual framework I derived through review of medical literature (Figure 2.2); others were emergent. In addition to keywords, emphasis, and non-verbal communication, metaphors were scrutinised. Metaphors are typically examples of shared cultural understanding, and may be used to emphasise points the participant wishes to make clear and implicitly convey perceptions the individual may take for granted (Quinn, 2005). Comments reflecting reasoning were also searched for, to support the grouping of codes and development of sub-themes and themes. Comments reflecting reasoning were also used to identify relatedness between themes and to assist in the development of a schema depicting what informs individuals' perceptions, understanding and attitudes.

I read and coded all transcripts within NVivo. Initial coding identified the challenges associated with learning neurology and managing neurological cases, enjoyment of neurology, and the participant's responses to those experiences. Review of the audio transcriptions aided understanding of emphasis,

[3] NVivo Transcription, QSR International Available from: https://portal.mynvivo.com/transcription
[4]NVivo qualitative data analysis software; QSR International Pty Ltd. Version 13, 2020

pauses, and changes in comment direction. To limit misrepresentation, transcripts were re-read multiple times, and the coding was intensive with between 125 and 259 coded items per transcript. Overlapping and related codes were subsequently sorted and grouped into themes summarising the key aspects of challenges and enjoyment of neurology, and responses to those experiences. Themes were developed based on the codes and not pre-determined but may have been influenced by the conceptual framework and previous literature (see Chapter 2). I reviewed the context of coded data within transcripts as the codes were sorted, to ensure that data were appropriately grouped. The appropriate grouping of data codes was again reviewed during exploration of each theme. Quotes and their context within the transcripts were used to verify whether the data supported my interpretations or not. Additionally, context obtained through repeated reviews of the transcripts provided evidence of links between themes. Review of quotes within transcripts also contributed to the identification of participants who expressed apparently contradictory comments or did not conform to the perspectives typically expressed by others with similar attitudes towards neurology. In such cases, the transcripts provided possible links to other themes that could contribute to the development of the alternate perspective. New groupings and interpretations were sought when my review of data coding within the context of the transcripts did not support my initial interpretation or when a thematic element did not fit within the boundaries of an existing theme.

Participant numbers were determined based on the findings of Larsson and Holmström (2007) who suggested that a sample size of 20 individuals is typically appropriate for phenomenographic investigations, although smaller numbers of interview participants have been suggested to be adequate to achieve data saturation (Collins, 2010). Researcher certainty (the confidence that there is sufficient understanding of the subject and that the research questions have been answered in a way that is likely correct) has been suggested as an appropriate measure to detect the endpoint of data analysis in qualitative research (Morse, 2010). In my analysis, the number of participants included was sufficient to provide confidence that there was enough data to understand a range of contributing factors to veterinarians' differing perspectives of neurology; the same thematic elements were identified in different participants even if those themes influenced attitude towards neurology in different ways.

Coding was solely performed by me, and I intermittently sought advice from my supervisors regarding the coding and developing themes. This helped identify any inconsistencies, overlap and potential alternate interpretations of statements.

Participants were not provided with the opportunity to review the interpretation of their data. Data analysis may lead to abstraction of the findings which can interfere with the participant's recognition of their contribution and cause conflict in interpretations (Morse, 2015). Furthermore, the interpretive process underpinning qualitative analysis means that the researcher's analysis of the data is intended to create a deeper understanding of the entire dataset. Participants are not privy to the data provided by others and may be constrained by more superficial, descriptive understanding (Varpio et al., 2017). These issues can restrict interpretation to a superficial level, impeding the quality of the data analysis and the results obtained.

4.2.3 Participants

Purposive selection of participants was performed so that the interview sample included veterinarians with a range of perspectives of neurology. Inclusion criteria included a veterinary degree, clinical experience of veterinary neurological cases, and recollection of learning neurology as an undergraduate. Clinical experience was necessary to ensure participants could discuss practical and "real life" challenges and rewards encountered with neurological cases.

An invitation to take part in interviews was circulated via a Massey University veterinary staff email listserver and word of mouth. Additionally, veterinary colleagues from outside of Massey University who had previously expressed interest in the research, were approached directly and invited to participate. The latter group included neurology specialists who were members of the European College of Veterinary Neurologists. Snowball sampling recruited further participants from among participants' acquaintances, both within and outside of Massey University. Snowball sampling has been criticised for potentially reducing the representativeness of samples (Parker et al., 2019). However, while a sample may not be considered representative, it can ensure inclusion of individuals who represent the phenomena of interest (Trow, 1957). In qualitative research, non-random sampling, such as snowball sampling, has therefore been considered preferable as it reduces the risk of diluting phenomena of interest (Richards & Morse, 2013). In my sample, snowball sampling increased representativeness of the wider veterinary population through recruitment of more production animal veterinarians. Additionally, some participants recruited through snowball sampling expressed unique views that would have otherwise been lost.

Veterinarians who responded to the invitation were asked to indicate the attitude statement they best identified with: a) Overall, a negative opinion of neurology and would choose to avoid dealing with neurological cases if possible/if an alternative option is available; b) Some negative perceptions of neurology, but don't allow this to completely put me off neurological cases; c) An overall neutral/indifferent attitude towards neurology; d) Enthusiastic about neurological cases and enjoy neurology. A maximum of five veterinarians per attitude statement were interviewed, with respondents selected for interview based on their attitude and availability. For the final interview question, participants were asked why they had selected their chosen attitude statement. This allowed confirmation of appropriate categorisation of each participant.

Participation was voluntary. Some participants were previous colleagues, and some participants were current colleagues as I was employed on a casual basis at the university while I studied and working part-time for a teleconsulting company. All participants were aware of my status as a specialist in veterinary neurology. To minimise reluctance to share experiences of failure, participants were reminded that the aim of the research was to understand what underlies veterinarians' attitudes towards neurology and that redaction would be performed when appropriate.

Eighteen veterinarians were interviewed (see Appendix B, Table B.1) and all 18 participants consented to use of their data. Only three respondents identified as having an overall negative opinion of neurology and would choose to avoid dealing with neurological cases if possible/if an alternative option is available; all other attitude categories included five participants. There were 12 female and six male participants. Three participants had primarily production animal experience, 14 participants had primarily small animal experience, and one participant had primarily mixed practice experience. Five participants were veterinary specialists, including two who had specialised in veterinary neurology. Ten participants had only general practice experience; two of these participants were not employed at Massey University. Although all participants had clinical veterinary experience, at the time of the interviews five participants held non-clinical roles. Participants' year of graduation was not recorded. However, five participants had less than five years of clinical experience; the remaining 13 had at least five years of clinical experience. Participants received their undergraduate training in one of six countries, spanning Asia, Australasia, Europe (including the United Kingdom), and North America. Clinical experience following graduation included at least 11 countries.

Six veterinarians discussed changes in their attitude towards neurology and a further two veterinarians indicated improved perspectives that had not changed their overall attitude towards neurology. Information regarding a change in perspectives or attitude towards neurology was typically presented in response to the questions "Are there any particular experiences or factors that you feel has shaped your opinion of neurology?" and "Has your opinion of neurology changed over time?". Further information regarding these changes in opinion was obtained through comments participants made throughout the interview.

4.2.4 Presentation of Findings

The findings of the thematic analysis will be presented as main themes and the elements that contribute to those themes. Key points will be presented as further subheadings. The findings have been numbered to aid navigating the themes.

Brackets after participants names indicate whether they are enthusiastic and enjoy neurology, are overall indifferent to neurology, dislike neurology, or avoid neurology, for example, Charlie (enjoys), Holly (indifferent). When a participant's attitude towards neurology changed in a way that was relevant to the interpretation of data, this will be noted alongside their current attitude towards neurology.

The findings relating to changes in perspectives and attitudes towards neurology will be presented last (Section 4.3.7 Changes in perspectives and attitudes) as they incorporate aspects of the main themes and elements.

4.3 Findings

Four main themes characterised the perspectives and experiences of neurological and non-neurological cases provided by this group of veterinarians (Table 4.1). These themes were Understanding and Retention (see Section 4.3.2), Motivation (see Section 4.3.3), and Exposure (see Section 4.3.4), all of which were underpinned by the theme Values and Traits (see Section 4.3.5). The four themes were interrelated, creating a web-like network.

Participants' comments within each of the themes were both positive and negative, enabling identification of "push-pull" factors. Negative perspectives could push the individual away from enjoyment of neurological or non-neurological cases, while positive perspectives pulled them towards enjoyment. Context and the individual's personality and past experiences contributed to whether a theme or thematic element pushed or pulled. Examples within the discussion of each theme will attempt to express how factors could push or pull, and thereby influence veterinarians' perspectives of neurology.

Table 4.1 Themes and elements arising from veterinarians' experiences and perspectives of neurology and neurological cases, and their definitions.

Theme	Elements	Definition
Understanding and Retention		Self-perceived level of, and ability to, understand and retain theoretical neurology knowledge, and apply this knowledge in a practical situation.
	Complexity of Neurology	The perception that neurology is, or is made to appear, complicated.
	Connections in Understanding	The ability to see or make connections between pieces of knowledge; general understanding of neurological principles and their clinical application.
	Fundamental Principles	The perception of one's own and others' level of understanding of, and ability to understand, fundamental (foundation, basic) principles of neurology.
Motivation		What drove individuals towards case exposure or towards case avoidance (any case), including both internal and external factors.
Exposure		The level of exposure to neurology, both clinical and theoretical.
Values and Traits		Aspects of professional and personal life that were considered of importance; personality traits.
	Drive to Help Others	The desire to help animals and people, and the value placed on life and emotional connections.
	Intellectual Challenge	The enjoyment of learning and need to be challenged.
	Self-belief and Drive to Improve	Resilience and effects on motivation and perception of self in response to perceived failure.
	Tolerance of Uncertainty	The level of comfort when dealing with the unknown.
	Systematic Approach	The importance placed on, and the tendency to adopt, systematic approaches to different situations (clinical and learning).
	Need for Validation	The need to be seen, or to see themselves, as having done a good job.

4.3.1 Theme relatedness: Links between intellectual and affective themes

When asked to recall a clinical case, interviewed veterinarians typically chose a case because of their affective response to that case. Those affective responses related to patients, clients, and personal performance, and could be positive or negative. Cases chosen with a knowledge-centric filter also tended to reflect affective responses, such as satisfaction gained through stimulating challenge, learning and the ability to avoid future mistakes even if clinical outcome was poor. All cases involved some uncertainty that had to be overcome. Therefore, affective responses typically underpinned participants' discussions.

Similarly, although the theme Understanding and Retention relates to intellectual difficulties learning neurology, participants often discussed understanding and retention in conjunction with factors such as motivation and exposure, and their affective responses to difficulty or improved understanding and retention.

The themes of Motivation and Exposure bridged the intellectual theme of Understanding and Retention and the main affective theme Values and Traits. Motivation was influenced by what individuals valued and could increase or decrease efforts to understand and retain neurology knowledge. Motivation could also be increased or decreased by understanding or retention of knowledge and affect whether values were upheld. Similarly, Exposure had the potential to drive participants towards greater or lesser understanding and retention, and risked exposure to negative affective responses as well as positive responses.

4.3.2 Understanding and Retention

> "Neurology, in my head, is like the thing that never has an answer to it."
>
> (Lisa, dislikes)

The theme of Understanding and Retention related to self-perceived intellectual difficulties with neurology, including the perceived level of understanding and retention of theoretical neurology knowledge and the individual's perceived ability to understand and retain that knowledge. All participants discussed intellectual factors associated with understanding or retention; this was the second largest theme in terms of the number of coded comments.

Many participants discussed their experiences of learning neurology, including their perspectives of undergraduate teaching and the curriculum, their method(s) of learning, and reflections on difficulties they experienced. Difficulties and successes understanding and retaining neurology knowledge were caused by both external and internal factors. External factors were beyond the individual's control, for example, curriculum or teaching based factors, or access to appropriate resources. Internal factors were specific to the individual, for example, the individual's ability to visualise abstract concepts, or how relevant they considered what they were taught.

Lack of understanding could create a vicious circle. Inability to obtain a diagnosis decreased what participants could learn from cases. Decreased learning from cases limited knowledge that might be applied to future cases. In some situations, a lack of answers was due to inherent limitations in our understanding of the human and animal nervous system: "half the time it seems to come down to deciding it was an idiopathic something or other, and that nobody knows what to do about it" (Zoe, avoids), "you have to tell them like, 'oh, like we're really sorry, but we can't really get to the bottom of your seizuring Labrador because there's nothing that I can find'" (Lisa, dislikes). Other times there was limited access to advanced diagnostic tests, due to cost or logistical considerations, reducing the likelihood of reaching a diagnosis.

Three thematic elements emerged from discussion of difficulties understanding and retaining knowledge of neurology: Complexity of Neurology, Connections in Understanding, and Fundamental Principles. These elements are discussed below. Although distinct, these elements were inter-linked (Figure 4.1).

4.3.2.1 Complexity of Neurology

The thematic element Complexity of Neurology refers to participants' perceptions that neurology is, or is made to appear, complicated. The perception of complexity included the level of detail associated with learning neurology, the interactions between different parts of the nervous system, the clinical manifestations of neurological disease, and the ways neurology was taught to undergraduates.

The effects of complexity on learning: over-complication and loss of relevance

Almost all participants spoke of the level of detail associated with learning neurology. Participants in all attitude categories expressed the opinion that teaching of neurology could be, and would benefit from being, simplified with a greater focus on clinical relevance.

Over-complication risked negative perspectives of neurology. Charlie (enjoys) noted that over-complication can be especially problematic amongst veterinary undergraduate students beginning to learn neurology: "if you've lost them, you don't get them back". This sentiment was echoed by Zoe (avoids) who noted that "the early uni experience definitely had a big impact" on her subsequent and persistent negative perspectives of neurology. Sara (avoids) and Sienna and Lisa (both dislikes) shared similar comments suggesting their undergraduate learning experiences of neurology had a profound influence on their on-going negative perspectives of neurology.

In contrast, when neurology concepts were simplified, epiphany-like moments were experienced by participants whose perspectives of neurology had improved over time, such as James and Tessa (both indifferent) and Charlie. Such moments were described as "demystification" (James) when things "started to make sense" (Charlie, enjoys). James summed up the issue:

> "You can make it very approachable, whereas you could also make it very unapproachable if you... if you chose a different... different delivery route for that information." (James, indifferent)

A focus on small details often impaired individuals' perceptions of relevance and risked their ability to understand wider concepts. For example, undergraduate focus on neuroanatomy pathways, cellular level neurophysiology and small details risked disconnection of information from a holistic structure. Such disconnection limited the ability to apply what was being learnt to a clinical scenario, creating an impression that neurology was "very specific, but at the same time ... it seems much more vague" (Heidi, indifferent).

Loss of holistic understanding led to difficulty seeing relevance. As Michael (enjoys) noted, undergraduate reliance on teaching staff for guidance as to what is important further meant that staff interests and bias could predispose to unnecessary detail and additional loss of relevance: "to [some of the teaching staff], you know, um, laryngeal paralysis and the cricoarytenoideus dorsalis is just as important as this tiny little nerve that– it does absolutely nothing." Zoe and Sara (both avoids) were also among those who criticised the level of undergraduate focus on small and cellular details. Zoe described how learning neurology was "hideous" due to the detail of neuroanatomy and having "to identify all these teeny, tiny little bits of brain". For Zoe, the holistic understanding of the nervous system was lost through the curriculum focus on small, complex details:

> "Instead of starting from a big picture, you know, 'this is the basics of the nervous system. And this is what the sympathetic and parasympathetic, and... that', it was very, very... yeah, it was right down at the... with action potentials it's not really the cellular level, but it's not too far up from it. Yeah, yeah. And all those horrible little synapsey things and stuff going across them and things." (Zoe, avoids)

Tessa expanded on this to explain how such detail and loss of holistic understanding could create difficulties when trying to apply knowledge of neurology:

> "Because of, like, so much focusing on the neuroanatomy side of things, you... in [sic] the end of the day, you miss out on remembering … the big, obvious localisation helps, because you try to memorise where the vagus is running or whatever, which is the third neuron for the Horner syndrome." (Tessa, indifferent)

Ultimately, learning potentially unnecessary detail at the expense of understanding broader fundamental neurological principles risked negatively affecting the individual's future approach to and management of a neurological case, creating confusion and the potential for mistakes.

The level of detail to be learned was further exacerbated by the introduction of new terminology: "the names start to get scary after a while" (James, indifferent). Unfamiliar terms also risked disconnecting neurology from other clinical disciplines: Such issues were highlighted by Grace when she discussed how her ability to retain neurological knowledge was hampered by the use of neuroanatomical terminology instead of more commonly used terms:

> "Partly, I think it's the... the words. You know, this lesion is probably- ah, I'm going to make this up, the lateral nucleolus of the reticulo-whosey-whatsit system. You know, I think it's a bit like ophthalmology. Can't you just say spasm? Can't you just say inflamed? You know, you know [sic], can't you just say squint or so- you know, do you have to have these friggin' big words for everything?" (Grace, avoids)

Differences in perceptions of relevance

As will be discussed in Section 4.3.3 Motivation, perception of relevance was often important in shaping participants' perspectives of disciplines. If participants could not perceive the relevance of detail, it was likely to negatively affect their perspectives of the discipline.

However, there were differences in perceptions of what was relevant. Participants with more negative attitudes towards neurology focused on how neuroanatomical and neurophysiological detail was of limited relevance. Mel (dislikes) noted, "sometimes I think, well, does it really matter? Um, as to… where we're going to go from there" while Sara commented:

> "I struggle with thinking, does a student need to be able to localise what part of the brain a lesion may be in, because the cat is presenting with these signs versus these signs. I guess, from an academic standpoint of 'gosh, it's interesting to know', but is it actually going to change anything to say, 'well, it's got a tumour or it's got an abscess, and it's in this part of the brain versus that part of the brain'? Um, because I think the sa– you know, the treatment's going to be the same at the end of it all." (Sara, avoids)

In such cases, detail was considered to unnecessarily add to the complexity of neurology. In contrast, participants with more positive attitudes towards neurology put greater relevance on neuroanatomical and neurophysiological detail due to its importance in making connections (see 4.3.2.2 Connections in Understanding, 4.3.2.3 Fundamental). While acknowledging that neurological theory needed to be simplified, participants such as Charlie and Max (both enjoys) tended to focus on students' inability to see the relevance of what was taught rather than the material being irrelevant. This is further discussed in Section 4.3.3 Motivation.

Complexity arising from abstract concepts

Loss of holistic understanding was exacerbated by the abstract concepts of neurology. A need for concrete, preferably tangible, concepts was referenced by participants such as Lisa (dislikes), "the stuff that you can't see. That's my problem". Similar comments were made by Zoe (avoids), Emilia and Mel (both dislikes), James and Holly (both indifferent) and Calia (enjoys), particularly in relation to difficulty understanding the brain. The myriad of pathways within the brain appeared to be viewed as complex, abstract, and unrelated concepts, rather than a wide network of modulating functions. The brain was described as "a big mystery" (Zoe, avoids), "completely complicated" (Emilia, dislikes) and "more intimidating" (Holly, indifferent). Grace (avoids) commented that she knew "we did stuff in anatomy and things, but... it didn't really... didn't really mean anything". Lisa (dislikes) made a similar comment: "I have a hard time understanding what it means if this cat doesn't pull back its leg when I pinch it or something like that. Like, I can see that it doesn't do it. But... then... the only thing I can tell the owner is like, 'oh yeah. Like it doesn't, it doesn't work... anymore'". Difficulty grasping abstract concepts of neurology created barriers to connecting neurology with other areas of knowledge and seeing the overall picture.

Additionally, several participants noted that veterinarians simply don't know enough about the animal nervous system: "I feel like it's still in its infancy, especially in the veterinary field" (Calia, enjoys), "we don't have the means that human medicine could have or the knowledge that- that human medicine has" (Jenson, enjoys). Such gaps in veterinary knowledge of the nervous system further added to the abstract nature of neurology, its perceived complexity and its inherent uncertainty.

Promotion of superficial learning strategies and impairment of knowledge retention

Complexity was linked to superficial learning strategies, particularly in an undergraduate setting. Time constraints, volume of information, inability to see relevance, and difficulty making sense of neurology pushed Sara, Zoe and Grace (all avoids), Mel, Lisa, Sienna and Emilia (all dislikes), James, Tessa and Wes (all indifferent), and Charlie and Michael (both enjoys) towards rote- or strategic learning of undergraduate neurology. In other words, participants in all attitude categories described their experiences of rote-learning neurology.

Superficial learning appeared to be a common approach when learning neurology, with Sara and Zoe (both avoids) and Sienna (dislikes) suggesting that similar learning strategies were employed by classmates. Notably, superficial learning strategies were adopted for many subjects during undergraduate studies, not just neurology: "it was rote-learning for me, for most of vet school, if I'm honest" (Sienna, dislikes), "I used to cram a lot … just kind of cram... for the exam, 24 hours beforehand and regurgitate it and didn't have that deep kind of learning to it" (Michael, enjoys). The wider use of superficial learning strategies was in some cases attributed to overall course workload, for example, "I mean, it's vet school. The amount of work is just insane … There's just no time to kind of spend the amount of time that you need to... learn it" (Michael, enjoys). However, there was also the potential for habitual adoption of the strategy.

When asked about their experiences learning neurology, many participants spoke of their poor retention of neurology knowledge. Poor retention of neurology knowledge tended to be linked to comments reflecting superficial learning approaches, for example "every year I read up about it and then I just forget it" (Zoe, avoids). Grace (avoids) spoke of how "when I read it … I was like, 'wow, that's really interesting', you know … but I- I can't remember it". Recall of undergraduate knowledge was poor "because it never made sense" (Charlie, enjoys) and "it just never clicked" (Lisa, dislikes), with Grace and Emilia (both dislikes) also citing a lack of understanding. Inability to clinically apply rote-learned knowledge was noted by Sienna (dislikes), and Wes and James (both indifferent), suggesting that superficial learning strategies negatively affected the ability to create connections in knowledge. This was echoed by Tessa:

> "You read, you remember all the cranial nerves, you have, like, 500 mnemonics of how to remember which is doing what. And then I'm like, 'OK, then what? (Laughs.) You know, what am I doing with this? (Laughing.) What's this for?'" (Tessa, indifferent)

Complexity and time constraints promoted superficial learning strategies, which further impeded the development of connections in understanding that could aid retention of knowledge.

In summary, Complexity of Neurology was linked to negative perspectives of neurology for most participants. Complexity of Neurology was particularly associated with negative undergraduate learning experiences, difficulty perceiving relevance of what was learned, and perceived disconnection between theoretical and clinical neurology.

4.3.2.2 Connections in Understanding

The thematic element Connections in Understanding refers to participants' ability to see or make connections between pieces of knowledge. Connections in Understanding included both general understanding of neurological principles and their clinical application to neurological disease.

Clinical confusion and its effects on perspectives of neurology

A lack of connection between theory and clinical application was frequently linked to negative perspectives of neurology. Charlie (enjoys) drew on her early negative perspectives of neurology when discussing how a lack of connections could lead to avoidance: "you just don't want to see it. You just want to refer it". Participants who struggled to see connections tended to speak of both lack of understanding of the underlying theory and inability to interpret clinical manifestations of neurological disease.

Sienna (dislikes) repeatedly described "that feeling of … 'what I do with this thing?' and, um, you know, just not– not really even knowing– not having an approach to it", indicating that a lack of connections limited one's ability to create a plan to move forwards with a case. Lisa (dislikes) and Sara (avoids) also noted how difficulty interpreting clinical manifestations of neurological disease created difficulties when communicating plans to clients. James (indifferent) expanded on this, explaining that owners also found it difficult to understand the significance of neurological signs whereas "if I can show them that they have a melting ulcer … it's a lot easier to demonstrate. … There seems to be a little bit more of a [sic]... understanding".

As well as discussing their own experiences, Zoe (avoids), Sienna and Mel (both dislikes), and Charlie (enjoys) recognised others also lacked these connections. For example:

> "My flatmates and I tried to practice a neuro exam on our various dogs but gave up. I mean, all we'd ever do was do this [demonstrates proprioceptive paw positioning response testing]. 'What does it mean?' 'Oh, I dunno.'" (Sienna, dislikes)

> "It's more difficult interpreting the results. … People going 'oh, well, what's that really testing, you know, when you do this knuckling thing, what's that really testing?'"
> (Mel, dislikes)

Conversely, making connections between theory and clinical application was associated with improved perspectives of neurology: "you go, 'oh, really, you know, that's not– it's not that... scary, or fuzzy, or, you know, it's really... it's not magic'" (James, indifferent but previously had negative perspectives of neurology). Charlie (enjoys) also spoke of the influence that creating connections had on improving her perspective of neurology, going on to say "I think my passion about it is because... overall, the connection that you have with the– with the neuroanatomy, the neurophysiology and the clinical signs. How you can connect all of that".

The perceived importance of connections

All participants spoke of the need for connections to understand and apply knowledge, or the inability to make these connections. However, connections were not necessarily prioritised when learning neurology as they were not necessary to pass courses. For example:

> "I'd learned it for the sake of being able to regurgitate it on a piece of paper for an exam, but I didn't actually understand what it meant." (Wes, indifferent)

> "And then just hope that you could apply that rote-learning knowledge in the... exam. If you needed to. But often you didn't need to. Often you just needed to spew it out."
> (Sienna, dislikes)

Such comments suggested that either the importance of making connections was not fully appreciated by learners or that other factors, such as time pressures or the curriculum delivery, hindered the ability to make connections. Both possibilities risked failure to make connections becoming habit.

As noted in Section 4.3.2.1 Complexity of Neurology, the making of connections was hampered by difficulty interpreting and perceiving relevance of information. Mel (dislikes) noted part of her difficulty making connections stemmed from her "didn't sort of know that what– what each individual piece of information gave you and how important that was", with similar sentiments echoed by Zoe and Grace (avoids), Sienna (dislikes) and Charlie (enjoys). Relevance of information was the basis for clinical decision-making for most, if not all, participants. Therefore, inability to appropriately interpret findings made it difficult to determine a plan to move forwards with the case.

Most participants discussed the need for a structured approach when learning or applying neurology. Frameworks helped make connections more explicit and provided a point of stability and reference when details threatened to become overwhelming.

> "Even though I wouldn't always get the right answer, I didn't always know what the answer would be, I had– I could work through them in a logical way and get to a, sort of, semi-list of, you know, what might be likely and where I was going to go next. Whereas with neuro stuff … I didn't." (Sienna, dislikes)

However, structured approaches could also prevent connections being made if the structure removed the need to understand. Grace (avoids) and Emilia (dislikes) expressed difficulty understanding the subject and spoke of their preference for algorithms to direct them to answers. In such situations, it was the algorithms that made the connections, not necessarily the individual. The potential downsides of externally made connections are discussed further in Section 4.3.5.5 Systematic Approach.

Learning-associated impediments to, and promoters of, connections

Participants commonly blamed undergraduate teaching for their failure to create connections between theory and clinical application of neurology. Zoe, Grace and Sara (all avoids), Mel and Sienna (both dislikes), James, Holly and Tessa (all indifferent), and Charlie, Michael and Max (all enjoys) discussed how theory was often taught in isolation from clinical application or relevance, and often at least a year before clinical application was taught. By the time participants reached the phase of their undergraduate training in which they needed to apply their knowledge, many had mostly forgotten it. Sara, Grace, Sienna and James and Sara noted there was little repetition to build on any connections made, with James failing to "remember ever... working on a live dog or a live cat, saying this is how you do a neuro exam". Even Wes (indifferent), one of the most recent graduates, "could not tell you who taught … us neurology", consistent with others' reports of little repetition.

Additional contributors to participants' reduced effort in revisiting theory and creating connections included time constraints (Emilia, Grace), workload (Emilia, Grace, Michael), low motivation (Zoe), poor resources (Sara, Sienna, James), and preconceptions of difficulty following earlier learning (Grace, Sienna, Lisa). These contributors influenced the likelihood of a participant creating connections as an undergraduate and when reviewing neurology after graduation, and will be discussed further in Sections 4.3.3 Motivation, 4.3.4 Exposure and 4.3.5.3 Self-belief and Drive to Improve.

The importance of clinical application in making connections and achieving understanding

Explicit connection of theory to clinical application and exposure to clinical cases was generally considered a vital step in achieving understanding, “because otherwise it can seem quite esoteric” (Sara, avoids). The general perception was that “you learn better from... your own personal experience with cases rather than totally an... academic kind of way” (Mel, dislikes). Sara and Grace (both avoids), and Mel, Sienna, and Emilia (all dislikes) particularly emphasised how clinical application and exposure could consolidate fundamental principles, increase confidence, and help create step-by-step protocols for case management. Participants with negative perspectives of neurology tended to place more emphasis on the importance of practical and hands-on learning for gaining clinical comfort and problem recognition, and less on deeper understanding of the underlying theory. For example:

> “I reckon you could do it with pattern recognition and a modicum of... whatever. Because we don't remember any of that stuff. You know. I can take someone, and I can go, ‘so if the potassium level goes up, it affects your depolarisation, therefore your heart's going to go slower’... and they can just learn that. No one's going to ask them to draw the TCA cycle... or a representation of an action potential. No one's going to ask them to do that. … I do think with case-based learning, I could create a vet out of a layperson in a year. And I don't think anybody would know the difference.” (Grace, avoids)

Participants who were more positive towards neurology also spoke of the usefulness of practical learning. However, they focused more on the need for pre-existing underlying theory and the role of practical experience in increasing understanding. For example, James (indifferent) described role modelling, Wes (indifferent) noted the importance of being responsible for cases, Michael (enjoys) discussed repeated links between clinical presentation and neuroanatomy, and Charlie (enjoys) and Heidi (indifferent) noted that eureka moments—the moments in which understanding suddenly and triumphantly becomes clear—were not possible without having already been introduced to fundamental principles:

> "I feel like I'm still learning, um, when I– when I read stuff on that. And I'm like, 'oh, that– that makes more sense now. Now I understand that, yeah'. You know, you see organophosphate, or carbamate toxicity and you go, 'oh yeah, that makes sense why they have those muscarinic signs, and those nicotinic signs and which neurotransmitters are involved and why that happens'." (Heidi, indifferent)

Visualisation and the ability to make connections

Associated with discussions of the need for clinical application and exposure, visibility and being able to physically see what was to be learnt were often considered important for creating connections. Descriptions without visuals were "a bit… meaningless" (Sienna, dislikes), with Charlie (enjoys) stating that "neurology cannot be explained by just text". Sara and Grace (both avoids), James and Heidi (both indifferent), and Max (enjoys) perceived visibility increased recall, aided perception of relevance, and promoted interaction, while Sienna, Jack, Emilia, and Lisa (all dislikes) were explicit about their reliance on visibility to create sense. Videos, clinical vignettes, and interactive diagrams were all discussed as methods for improving learner's ability to make connections and increase understanding and retention. Grace (avoids) and Mel (dislikes), and Wes and Heidi (both indifferent), also spoke of the importance of visual hands-on experiences when learning, with tactile stimulation and spatial awareness aiding understanding: "you can see... what's going on", Heidi.

As noted above, being able to see the clinical manifestations of neurological disease but not the process(es) by which those manifestations developed made discussions with owners difficult. Additionally, even if the underlying cause of the clinical signs could be seen, the explanation for how 'A' led to 'B' often remained elusive due to inability to apply theoretical knowledge. Participants contrasted these difficulties through discussion of clear visual abnormalities involving broken bones (Emilia, dislikes; Michael, enjoys), surgical exploration (Mel, dislikes; Michael, enjoys), and cytological evaluation (Grace, avoids; Sienna and Emilia, dislikes; James and Wes, both indifferent).

Logic and the building of connections

Logic provided an alternative method of "seeing" connections. Participants tended to utilise logic in one of two ways. Firstly, participants used logic to direct a methodical and systematic approach to case management, whether they understood all findings or not. In these situations participants such as Grace (avoids), Tessa and Holly (both indifferent), and Calia (enjoys), focused on specific information they believed would lead to answers. For example, "you don't even need to know... what kind of neuro as long as you know, 'OK, it's a head case'" (Calia), breaking down the neurolocalisation to “is it a head? Is it a spine? Is it peripheral?” (Tessa), or focusing on specific clinical presentations of disease “like 'the seizure dog', and the... 'spinal dog'” (Holly).

Secondly, participants (primarily those who enjoyed neurology, but also Jack (dislikes), James and Heidi (both indifferent)) used logic to connect their understanding of fundamental principles with clinical manifestations of neurological disease. Logic allowed these participants to interpret their clinical and diagnostic findings and draw conclusions, even in novel situations.

> “It made sense. If you had a lesion, it would affect X, Y and Z, and these were the signs you would see. … Some of the other things, it's very much, ‘well, it could be this, or it could be that’, whilst with neuro it was, ‘the lesion is here. This is why we see this’.”
>
> (Jack, dislikes, previously enjoyed)
>
> “If you know your basic pathophysiology, you can understand, um, by identifying a sign that will point you towards, um... some other body system. And ahh, it's very ordered … One part looks after the other and modifies, you know, actions and those sorts of things. So... [you can] localise lesions and then depending on the age of the animal, the age, the breed, or the type or how it happened, you can predict pretty closely what it was likely to be.” (Max, enjoys)
>
> “[It’s] a very logical discipline, um... everything makes sense, or you can draw a conclusion based– a lot of conclusions based on your neuro exam.”
>
> (Jenson, enjoys)

Logic also enabled application of theoretical understanding to try to find connections between seemingly disparate clinical findings, which in turn helped advance understanding.

> “You know, you've got action/reaction, or you've got, you know, this travels to there or, you know, anatomy's important. And so, um, that was... that was very useful.”
>
> (James, indifferent, describing how logic helped him see connections and improved his perspective)
>
> “You work through these pathways and... and then you see the clinical signs, and– and then, um, how you can reverse those clinical signs.” (Charlie, enjoys)

Both uses of logic allowed participants to counter uncertainty and make progress with clinical cases. In contrast, inability to use logic in these ways prevented connections being made.

In summary, the ability to create connections was vital for clinical application of neurology knowledge. Clinical application of knowledge is central to most veterinarians' careers. A lack of connections was primarily referenced by participants with negative perspectives of neurology, or participants who previously held negative perspectives of neurology. Lack of connections resulted in intellectual difficulty progressing with clinical cases. Following algorithms allowed veterinarians to manage neurological cases but did not necessarily aid subsequent development of connections or understanding. In contrast, having those connections increased positivity towards neurology through confidence and perceptions of making progress.

A lack of connections was often blamed on undergraduate curricula, workload, and teaching, but could also result from an inability to directly visualise cause and effect in a clinical context or bridge this gap with logic.

4.3.2.3 Fundamental Principles

The thematic element Fundamental Principles refers to participants' perceptions of their (and others') level of understanding of, and ability to understand, fundamental principles of neurology. Fundamental Principles related to aspects of neurology that were considered foundation or basic knowledge, not high-level detail.

Approximately half of the participants struggled with learning or understanding "the basics" of neurology or the effects of not having those fundamental principles at some point in their veterinary training. For example:

> "Just that, sort of, feeling of not having that grounding, not having the basics- the basics, really, because I think everything builds on that. So I feel like I'm on, sort of on shaky ground because I don't have that fundamental structure of understanding of... yeah, pretty basic stuff." (Sienna, dislikes)

> "At university I didn't understand a lot of what [the lecturer] was saying. Um. It was basically complete gibberish. … The basic stuff like, was more like, trying to read deLahunta, which didn't make any sense, because it didn't make any sense from chapter one. Um. So that was very hard to get through." (Lisa, dislikes)

> “Coming from vet school we didn't learn very much useful about it. I remember like having to trace all the nerve pathways up and nobody ever told us how it was... how it was applied. So coming out into practice when we did see neurological cases it was a little bit of a struggle because nobody'd ever taught us how to do a neuro exam or (laughs) knowing what the different treatment options are. So I spent– any time I saw a case coming in, I spent ages on VIN just like Googling, like, what do I do now?”
>
> (Holly, indifferent)

> “And the whole class... well, my interpretation is that the whole class felt the same way, because we'd just been going, ‘we've no idea what this neuro thing is’. Because it'd just been crap. And it's a terrible thing to say, but physiology, when I went through, you had to answer five out of six questions in the exam, so I just didn't study it. Because I just- just went, ‘if there's a neuro question, then I'm not going to do it.’ (Laughs.)”
>
> (Zoe, avoids)

Like Zoe, Max and Michael (both enjoys) discussed others’ difficulties understanding the fundamental principles of neurology. This lack of fundamental understanding was associated with clinical difficulties with neurology, with undergraduate students “coming into clinical neurology without the basis or the background that's needed” (Max, enjoys).

> “I think... for some– one reason or another, a lot of people... never have a good mastery of neuro exam. And a lot of that is understanding. … And when they don't have a good understanding of what's going on and why, they're just trying to diagnose 'the neurological system'. And you can't... do that … it’s not pathognomonic.”
>
> (Michael, enjoys)

Impediments to gaining understanding of the fundamental principles of neurology included difficulty visualising both theoretical concepts and anatomical structures, poor learning resources, and low motivation to understand neuroanatomical pathways and neurophysiology. Most participants spoke of at least two of these impediments. These impediments could become additive. For example, Lisa (dislikes) spoke of her difficulty understanding concepts that were less tangible or “grab-able”, with her difficulties compounded by learning resources that were “complete gibberish”. Charlie (enjoys but previous negative perspectives) shared similar personal experiences and spoke of how she had seen low motivation in others. Zoe (avoids) also focused on poor teaching and learning resources whilst acknowledging her own low perception of relevance and low motivation to learn neurology.

The importance of understanding fundamental principles for clinical application of neurology

All participants who enjoyed neurology considered fundamental principles essential knowledge if clinical manifestations of neurological disease were to be understood. Simply, connections could not be made unless fundamental knowledge was present. As Calia (enjoys) stated, “it doesn’t make sense if you don’t understand what the nerves and the vessels are supplying”.

> “The clinical part … of the teaching is when we can apply that knowledge to clinical cases and the neuroanatomy that they have been learning during the first and second year. And … I love when the students … say, ‘oh, now it makes sense’. … When they get to the third and fourth year, they have so many concepts in their brain, but they are not connected at all. ... What we want to do in our teaching is to connect all that knowledge, because... I'm not teaching any new knowledge. And this is, this is very sad, because you have your knowledge, but you cannot apply or make any sense about it. … They know the anatomy, they know the physiology, and– but they don't connect them. And … there is no way we can make sense... of everything, … if they... wouldn't have that concept... before.” (Charlie, enjoys)

Max, Michael and Charlie (all enjoys) discussed undergraduates’ struggles once reaching the clinical phase of their training if they did not understand fundamental principles, with Charlie also sharing her own experiences. Jenson (enjoys) echoed their comments, saying that once you had the fundamental principles of neurology and could “learn how to interpret the neuro exam, then it's pretty easy - most of the time at least”. Other aspects of neurology, such as treatment, could be learned through experience and were, therefore, considered less important than fundamental principles. As Michael noted, “the rest will just come with time”.

These perspectives contrasted with the opinions of participants who disliked or avoided neurology, such as Sara, Zoe and Grace (all avoids). As discussed in 4.3.2.1 Complexity of Neurology, participants who disliked/avoided neurology tended to question how much neuroanatomical and neurophysiological detail was truly necessary. At the same time, these participants had difficulty making connections in neurology knowledge and in applying that knowledge to clinical scenarios. Such participants appeared to place less value and relevance on the knowledge that contributed to fundamental principles, despite their acknowledgement that a lack of basic understanding of neurology contributed to their difficulties with neurological cases. Alternatively, it is possible that these participants had a different perception of what amounted to fundamental principles or did not recognise the contribution of neuroanatomical and neurophysiological knowledge to fundamental principles.

Having the basics did refer to more than just a detailed understanding of fundamental neuroanatomy and neurophysiology. The importance of clinical reasoning and context was discussed by Tessa and Heidi (both indifferent), and Charlie (enjoys). Jenson (enjoys) noted others' difficulty understanding urgency and Mel and Sienna (both dislikes) spoke of the perception that all neurological cases were urgent. Charlie and James (indifferent) also discussed failure to apply fundamental principles of clinical examination such as consideration of signalment and history, and a general physical examination, instead just "rush[ing] to do the neuro exam" (Charlie, enjoys).

Some participants seemed to believe diagnostic investigations could compensate for the gaps in their understanding. Grace (avoids) and Jack (dislikes) suggested interpreting the neurological examination was less relevant when they had the opportunity to perform advanced imaging such as MRI: "strictly speaking, the brain is not hard is it... if you've got owners who have money. … 'You give us four grand and I'll tell you what's wrong with it'" (Grace). Charlie (enjoys) recounted similar opinions amongst undergraduate students. In contrast, participants such as Tessa (indifferent), Max (enjoys), and Charlie, argued that lack of clinical interpretation and reasoning risked unnecessary testing and misdiagnoses, with advanced imaging giving "you the same, probably, ah… list of differentials" (Charlie) to those obtained by clinical reasoning.

The need for motivation to improve understanding of fundamental principles

Improved understanding of fundamental principles of neurology was primarily linked to experiences in which the individual encountered other ways of understanding those neurological principles. For James and Tessa (both indifferent), and Charlie and Michael (both enjoys), these encounters related to a colleague who simplified the fundamental principles of neurology or made these fundamental principles more visible. However, an underlying motivation to gain understanding was also evident when these participants recounted their experiences of improved understanding. For Charlie and Tessa this motivation was explicit; for James and Michael it was implicit through seeking out opportunities to engage with veterinary specialists. The effects of motivation will be discussed in more detail in Section 4.3.3 Motivation.

In summary, understanding fundamental principles proved pivotal for both expansion of knowledge and improving perspectives of neurology. Those with indifferent or positive perspectives of neurology often considered understanding of fundamental principles essential for avoidance of mistakes. In contrast, participants with negative perspectives of neurology did not necessarily recognise the importance of fundamental principles or what those fundamental principles were. Motivation was often needed to improve understanding of fundamental principles.

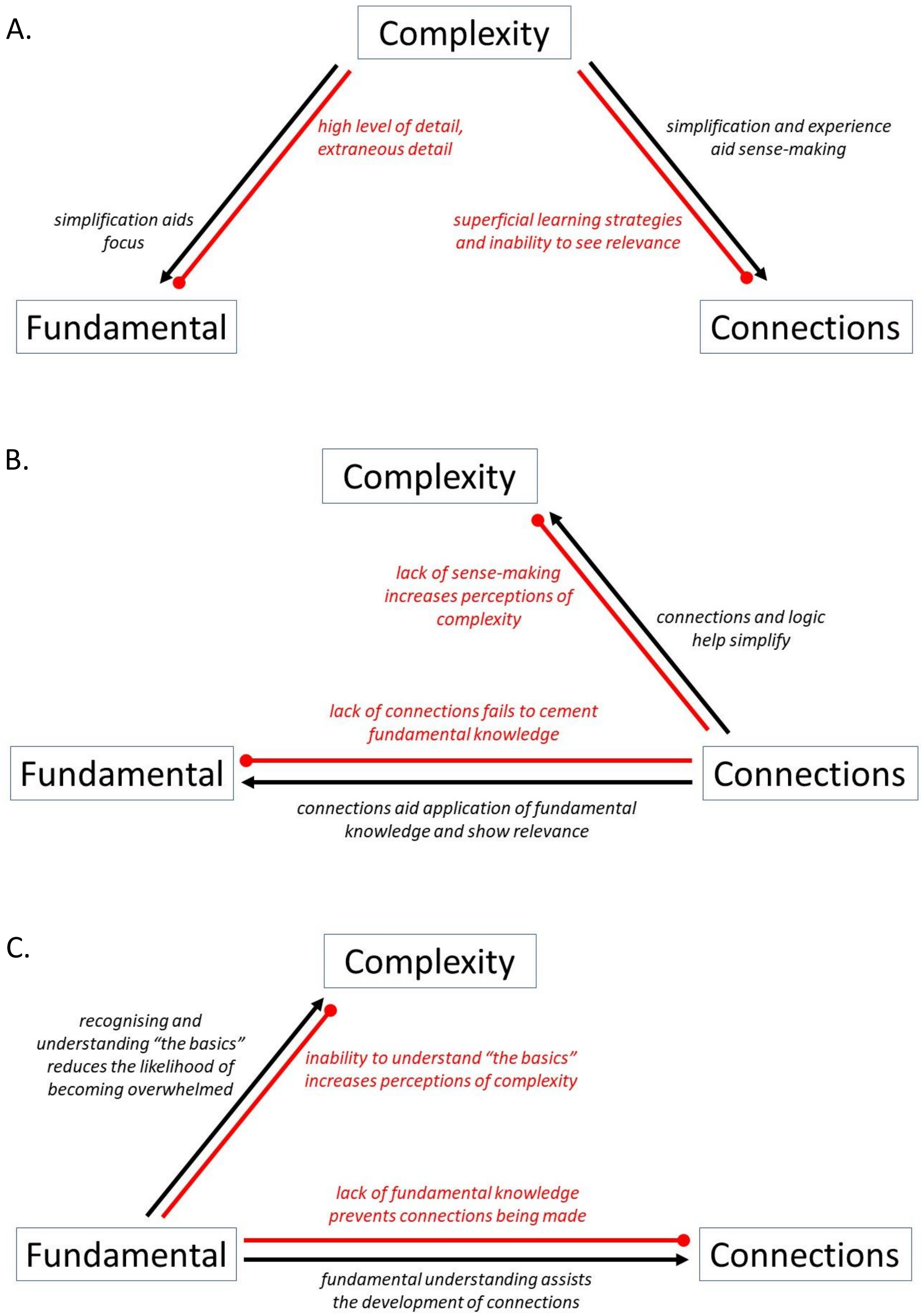

Figure 4.1 The relationships between the elements Complexity of Neurology, Connections in Understanding and Fundamental Principles. A) The effects of perceived complexity of neurology on the ability to establish connections in understanding and gain fundamental understanding; B) The effects of making connections in understanding on perceptions of complexity of neurology and the ability to gain fundamental understanding; and C) The effects of fundamental understanding on perceptions of complexity of neurology and the ability to make connections in understanding. In each diagram, the black lines indicate pathways between elements that aid understanding and retention. The red lines indicate pathways that inhibit understanding and retention. Arrows indicate the pathway is facilitatory, circles indicate the pathway is blocked.

4.3.3 Motivation

> "They just didn't learn it, so they'd just turn off. So, by turning off they had no… comprehension. They'd rather, then, refer it, I think, if they were in practice later on."
>
> (Max, enjoys)

The theme of Motivation referred to what drove individuals towards exposure to or avoidance of a discipline. Motivation included both internal and external factors and was potentially context dependent.

4.3.3.1 Internal influences on motivation

Interest was a profound motivator. Charlie (enjoys) frequently spoke of her passion, Calia (enjoys) of her fascination, and Jack (dislikes, but initially enjoyed) became animated when discussing aspects of learning that were "pretty cool". However, interest alone was not enough to maintain motivation. Jack described his experiences of neurology "as a student... amazing" but became disenchanted when discovering neurology to be less relevant to his career. Similarly, perceptions of low relevance were conveyed in conjunction with Zoe's (avoids) expressions of boredom and lack of interest, and Sara's (avoids) context-dependent interest in neurology.

A need for value and relevance were commonly discussed (addressed further in Sections 4.3.2.1 Complexity of Neurology, 4.3.2.2 Connections in Understanding, 4.3.2.3 Fundamental, 4.3.5.1 Drive to Help Others, and 4.3.5.3 Self-belief and Drive to Improve). What was valued and perceived to be relevant was dependent on the individual and was potentially contextual. Whatever the cause, less effort was expended to learn or understand aspects of veterinary medicine perceived as less valued or relevant: "honestly that put me off almost entirely because nobody, like, went back and said why we were actually... learning that or how to make it clinically relevant" (Holly, indifferent). Similarly, there was less effort to clinically apply aspects of veterinary medicine of less value or considered less relevant:

> "Often, it's not a great outcome anyway, you know, so it doesn't feel massively motivating to... to... put it in the effort really. When... yeah, what you're going to do, it probably isn't going to change [the outcome] hugely." (Zoe, avoids)

Additionally, Sara (avoids) noted “there was less need to make an absolute diagnosis around localisation of lesions, which meant I never probably really embedded that knowledge or followed up on it”. Low value and relevance therefore increased the risk of adopting superficial learning strategies.

Finally, perceptions of low value and relevance, including the perception of inability to act yourself and ease of referral, could also promote avoidance strategies. Referring to his views early in his career, James (indifferent) noted that “neuro was always someone else's problem. I was always either going to refer it or not treat it because, ‘oh it's neuro, here's some steroids’”. Max and Charlie (both enjoys) made similar links between avoidance of neurological cases and the perceived value and relevance of neurological understanding.

The influence of relevance and value on the levels of affective response to failure

Individuals’ perception of what constituted success varied. Participants were not necessarily concerned about lack of understanding or failure to retain knowledge perceived to be of low relevance or value. Whether an experience was considered successful or not, the importance ascribed to that event, and the influence of that success or failure on perspectives, strongly depended on the individual’s values and personality traits. This is discussed further in Section 4.3.5.6 Need for Validation.

Cues for value and relevance often came from owners, with several veterinarians speaking of how their perception of relevance was influenced by the owner’s perceptions of each animal’s value. For example, Sara (avoids) found that “when the owner had no real emotional involvement, [she] was more than happy to pull the pin on a case”, while Heidi (indifferent) discussed the potential emotional toll when the animal is valued by their owners: “most people are coming in on probably their worst day with their animal … it can be exhausting if you can't separate yourself out from that emotional... impact”. However, perceived value and relevance could also be independent of owner cues. For example, Sienna and Lisa (both dislikes) described cases that caused them stress despite the owners being relatively relaxed about their pet’s neurological signs.

A successful outcome, for example a patient’s return to a functional life, did not count as a “success” in all situations. For example, Zoe valued solving herd health problems over the health of individual animals. Even when owners placed value on an individual animal, Zoe did not always share their level of satisfaction in achieving a good outcome:

> “Neuro is mostly individual animals. And it's like, "eh". You know? You get called out to an individual animal case, it's like ‘mm. This will fill in an hour of my life, but I'm not sure how thrilled I am about it’. (Laughs) … I mean, you do get a little warm glow when you get the odd neuro case that actually ... you can... fix it and it's usually on a lifestyle block and the owner's very grateful, and blah. But in the grand scheme of things, it's... it's nice, but it's not... thrilling”. (Zoe, avoids)

In such situations, failure to achieve a successful outcome also resulted in less negative affective responses. In comparison, affective responses were stronger when a successful outcome was highly valued by the veterinarian or the owner. Grace (avoids) spoke of her worry over making the wrong clinical choices (“I only struggle with the things that– where what I do make a difference”). Failure to achieve an outcome of high value was associated with strong negative affective responses, with similar comments from Sara (avoids), Sienna and Lisa (both dislikes), Tessa and Heidi (both indifferent), and Charlie (enjoys).

High value was placed on meeting personal and others’ expectations, with specific reference to affective consequences of failing to do so (“I think that's one of the... the... sad and difficult and stressful, anxiety-provoking things for clinicians”, Grace; “that feeling of … humiliation … because … I should have known better”, Sienna). Such comments suggested elements of perfectionism and fear of failure were associated with failure in situations of high value.

Elements suggestive of perfectionism, such as self-expectations, and personal standards had the potential to be positive, such as those associated with self-belief and drive to improve (Section 4.3.5.3 Self-belief and Drive to Improve However, internal influences were negative when expectations of self were unrealistic or failure to succeed caused self-recrimination. For example, Sienna (dislikes) spoke repeatedly about her tendency to reflect failure onto herself: “even though I learned a lot from [mistakes I made], I still feel like ‘oof’ … I shouldn't have been allowed out”. Other participants, including Charlie and Jenson (both enjoys), spoke of how negative emotions could trigger avoidance strategies: “what is the easy way of … confronting … that? Avoiding it” (Charlie). In other words, individuals would seek to avoid situations that created negative affective responses.

For Sienna and Grace in particular, but potentially also Sara (avoids) and Mel (dislikes), Heidi (indifferent) and Charlie (enjoys), expending effort to learn required the need to address affective discomfort such as fear of failure, fear of appearing inadequate, and frustration. Difficulty understanding a subject could create a feeling of dissonance, with individuals used to success suddenly struggling to learn, with Grace (avoids) and Charlie (enjoys) commenting on this: “for me it was frustrating because I was a high achiever and I had very high marks, ah, um, in any other, um, ah, discipline" (Charlie). Perceived failure to learn could be confronting. Some individuals, such as Tessa and James (both indifferent), and Charlie and Max (both enjoys), used the need to resolve dissonance as motivation to improve. For example, James spoke of how he started "seeking out people, and saying 'hey you know, I've got this– this type of thing going on, interested to know... what you think is going on and I'm interested in what I did wrong, um... Can you help me?'" However, for individuals afraid of failure or appearing inadequate, affective responses to failure could counter the desire to learn and promote avoidance strategies rather than renewed efforts to succeed. For example, Grace spoke of her unwillingness to undertake postgraduate CPD in neurology, relating her concerns back to her experiences with a subject she had struggled to succeed in despite high expenditure of effort:

> "I would be worried that... I would start the course and just be hopeless at it. And so I think it's that fear of failure. It's like a physics course and everything, you know. Yeah. Yeah. I'm hoping I could just do enough to pass this." (Grace, avoids)

4.3.3.2 External influences on motivation

External influences could provide motivation beyond the previously noted perceptions of value and relevance. External influences on motivation included others' expectations, the effects of support or lack of support, and the enthusiasm of those around you. Most participants' comments regarding external influences related to positive motivators, although James, Heidi and Tessa (all indifferent), and Charlie (enjoys) noted that others' negative perspectives could also influence the perspectives of those around them: "my neurology instructor was, you know, the one we learnt 'localise and euthanise' from. Ah... so that's probably not a good way to present your case material and– and, um, engender this love of neurology into your students" (James).

Sara (avoids), Sienna (dislikes), Michael, Charlie, and Max (all enjoys) spoke of mentors. Mentors combined external expectations, encouragement, and support. Mentors provided a safe space for failure and uncertainty. For example, Sienna spoke of how her enjoyment of her favourite discipline largely developed through having a mentor "who was enthusiastic about it and never made you feel like a dick for asking questions". Charlie and Michael described increased desire to learn when teachers were passionate about their discipline, created interest and could show the practical application and relevance of what they were teaching. All participants who discussed frequent interactions with individuals who were positive about neurology also spoke positively about their own experiences with neurology. James and Tessa (both indifferent), and Charlie, Michael, Max, and Calia (all enjoys) spoke of having fun, receiving support, being motivated, and respecting their positive colleagues, peers, and lecturers. Tessa's neurology colleagues "made [neurology] accessible and they made it fun. … And we'd... support each other as well”. Notably, Charlie, James and Tessa had expressed early negative attitudes towards neurology that had improved partly due to the positive interactions. Tessa “believe[d] that [her comfort with neurology came from] being exposed to people that enjoy neurology … If they... if the students and the generations of vets are exposed to that, it's going to be very easy for them”.

Colleagues, both veterinarians and support staff, could also create a safety net to give individuals opportunities to learn and confidence to act. James, Heidi and Tessa (all indifferent), and Calia and Max (both enjoys) spoke of invaluable feedback and the feeling of inclusion. For James, the ability to discuss cases was far more impactful on motivation, learning and retention than attempting to research cases on his own. Calia and Heidi spoke of how discussing cases with colleagues could open new avenues when they had reached an impasse and turn confusion into enjoyment. This collegial support, “having... somebody that you could check in with when, you know, you, kind of… you were all out of your ideas, um, and– and going from there” (Heidi), helped to reduce anxiety and provide direction.

In contrast, a lack of support had the potential to reduce confidence and left some participants in a negative mental cycle. Lisa and Emilia (both dislikes) spoke of exhaustion, and feeling jaded, helpless, and disillusioned. Such mental effects could be marked: “I was crying going to work and … crying, going... going back home because I was too exhausted. And I didn't really have anybody to ask other than... phoning specialists at like... any place I could find, really” (Lisa). Grace (avoids) and Lisa (dislikes), and James, Tessa and Heidi (all indifferent) made specific mention of a lack of in-house support with neurological cases which stemmed from others’ discomfort with the discipline. In some situations, lack of support seemed associated with deficits in colleagues’ knowledge: “they're more of like, ‘oh yeah, just give it some steroids and it will be... it'll be fine. And if it's not, then... good luck’” (Lisa). In other situations, lack of support seemed associated with colleagues’ low confidence: “nobody will take a neuro case off your hands. Oh, they're all suddenly too busy. They're all looking the other way, you know, they're all like (laughs), all of a sudden, they've got … somewhere really important to be” (Grace).

4.3.3.3 Spirals of motivation

Regardless of what constituted success, success prompted positive affective responses, such as a “warm glow” (Zoe, avoids), or “instant gratification” (Mel, dislikes), and could lead to feeling “a little more optimistic” (James, indifferent). Repeated positive affective responses could increase motivation, with Sienna (dislikes), James (indifferent), and Michael, Charlie and Calia (all enjoys) describing situations in which they were able to build on their knowledge and skills, and situations in which they developed greater confidence in their ability to achieve future success. Despite previously considering his neurology knowledge “down at the bottom” and being “still not what I would consider strong in neurology”, James’ positive experiences had led to him becoming “happy… comfortable… with [his] abilities”.

However, the frequency of failure or difficulty achieving success could also influence motivation. Zoe noted that the tendency for her neurological cases to have negative outcomes had shaped her opinion: “if I have a neuro case, it's probably stuffed”. Expectations of failure led to production animal participants describing low motivation to proceed with investigations and treatment, and early recommendations for euthanasia. Calia (enjoys) observed these expectations of failure “when people get a neurology case and then... immediately they start thinking about euthanasia”. Jenson (enjoys) and Tessa (indifferent) also noted such perspectives in others, and how this led to adoption of avoidance strategies.

Similarly, several participants who disliked/avoided neurology expressed a perceived innate inability to understand neurology, associated with their repeated difficulty understanding or retaining neurological knowledge. For example, “I just feel like I could study neuro every day of the week and not get any better at it” (Grace, avoids). Somewhat contradicting herself, Zoe (avoids) explained her inability to retain neurology knowledge because “it just doesn't work” but also expressed her belief that if she tried hard enough, she would be able to understand it. Such comments suggested repeated failure to understand or retain neurology had created a degree of acceptance of failure.

In summary, levels, sources, and reasons for motivation influenced participants’ experiences and perspectives of both neurology and non-neurological disciplines in similar ways. Participants were more inclined to engage in and pursue experiences associated with high motivation and positive affective responses, and more inclined to avoid experiences associated with low motivation and negative affective responses.

4.3.4 Exposure

> “I ask someone to put it on deep bed straw and I get told to go somewhere.”
>
> (Jack, dislikes, discussing his repeatedly negative clinical experiences of neurology)

The theme of Exposure referred to individuals’ level of exposure to neurology, both clinical and theoretical. Exposure included the degree to which the veterinarian was able to investigate and manage the case, as greater case involvement meant more opportunity to gain experience. Exposure was therefore context dependent and heavily driven by practicalities and logistics.

Exposure to neurological cases created opportunity for positive perspectives of neurology, for example, through demonstration of positive outcomes (upholding the value drive to help others, Section 4.3.5.1), increased confidence (upholding the value self-belief and drive to improve, Section 4.3.5.3) and cementing clinical approaches to cases (upholding the value systematic approach, Section 4.3.5.5). However, exposure to neurological cases also had the potential to cement negative perspectives of neurology. Half the participants provided examples of uncertainty when discussing neurological cases. These participants linked uncertainty to negative effects on values and personality traits, including inability to help others (clients and patients), low self-belief and hindrance of drive to improve, and loss of validation. Therefore, the type of exposure was instrumental in determining the individual's type and strength of affective response.

4.3.4.1 Positive effects of exposure: repetition, familiarity, and confidence

Regardless of the discipline, exposure provided experiential learning that could be drawn on in future cases, and increased confidence. Almost all participants discussed the benefits of experiential learning, with Sara (avoids) referencing the positive influence of the "learning gradient" on skill development, while Zoe (avoids) noted how "doing a huge number of clinical exams every day" leads to "a really good feel for... what's normal". Similarly, participants noted how exposure to neurological cases could increase understanding and retention by creating connections between clinical manifestations of neurological disease and theoretical neurology knowledge: "things start to make sense when they learn... that foundational... um, information... during the early years, and then they can see it in practice and actually, like, integrate it within that patient. Um. So, and that's when it really makes sense" (Heidi, indifferent). Repetition cemented these connections and created a sense of familiarity, which also provided comfort when seeing similar cases: "the more you see, then the more you see respond to... you know, to supportive care … [you] definitely get more... more comfortable with it. 'Oh, yep. Yep, recognise that, know what to do, carry on' kind of thing" (Emilia, dislikes), "there was that moment of discovery, maybe after the fact, that this thing existed … then I was able to spot it the next time it happened. It's happened two or three times since … it's like, 'let's go'" (James, indifferent).

Some participants undertook further training in neurology, or closely collaborated with a neurologist, after graduation. Mel and Emilia (dislikes) undertook a short course (less than one year) and expressed some increase in comfort with neurology but little improvement in attitude. These shorter courses were primarily delivered via distance and centred around case-based delivery of theory rather than providing hands-on exposure. In comparison, Tessa and Heidi (indifferent), Charlie, Jenson, and Max (enjoys) undertook at least one year of training in neurology or collaboration with a neurologist and expressed greater positivity towards neurology. These longer courses or interactions included internships, residencies, and closer working relationships with specialists, and therefore offered greater collaboration with specialists, the opportunity for exposure to more cases, and greater personal involvement in cases.

4.3.4.2 Negative outcomes of infrequent and suboptimal exposure: stress, panic and low confidence

> "So if you never get that final part of it, and that's what I didn't get. … And … I felt way less confident … than I did with any of the other specialties. Um, so I think that if you don't solidify that learning in that critical time like that last year, last year and a half of... of study... um... yeah, then you've unfortunately, that's when you... you don't feel as good." (Heidi, indifferent)

Neurological cases comprised a relatively small percentage of many participants' caseloads, which further reduced opportunities for application and cementing of knowledge and skills. As Jenson (enjoys) noted, "you can see that [veterinarians] get lost, basically" when there is no repeated practical application of neurology knowledge. Grace (avoids), Emilia (dislikes) and Calia (enjoys) also noted that the infrequent presentation of neurological cases made it difficult to retain and recall an appropriate approach. Calia also noted that infrequency could negatively affect effort to maintain and retain the knowledge base:

> "It's so easy to not see a neuro case for days or weeks or months that you just tend to forget [your neurology knowledge] and you don't use it. And because you see it so infrequently, there's less pressure to be... um, aware of it and... to, you know, have a good, thorough understanding of it and how to deal with it." (Calia, enjoys)

Neurological cases were often presented in an emergency context with "owners freaking out" (Emilia, dislikes), adding pressure to rapidly make decisions and stabilise the patient. Grace (avoids), Sienna and Lisa (both dislikes), and Tessa (indifferent) spoke of the need for a clear approach in such situations, especially when cases were infrequent and unfamiliar. The need for a clear approach was, in part, because perceived severity and high stakes of neurological disease could further hamper recall of knowledge and create panic:

> "I was like, 'oh, my God. Like, what is this?'" (Lisa, dislikes)

> "That feeling of abject confusion at 10 o'clock on a Saturday night of 'what I do with this thing?' … [I] just freaked." (Sienna, dislikes)

> "I thought it was about to die. And, ah, and it was like, 'oh, my God'. And it was just a peripheral vestibular syndrome, but I thought the dog was dying." (Charlie, enjoys)

> "I remember being really panicked, thinking, 'oh, crap, have I found BSE [a disease with significant national implications]?' because I'd completely forgotten Listeria was a thing."
> (Jack, dislikes)

> "There is that kind of flurry of, 'oh [expletive], what's causing this?'" (Emilia, dislikes)

Participants spoke of needing time to organise their thought processes calmly and methodically and systematically work through their findings. Grace spoke of her (unfulfilled) need to be able to block off consult slots to work through neurological cases, while Emilia felt that if she "had an hour that I could sit down with this dog, what he was doing, and work it out, I think I would feel a lot more comfortable with it and actually volunteer to do it".

Insufficient exposure to neurology also risked exacerbating negative affective responses towards neurology. Almost all participants discussed practical difficulties associated with examining, diagnosing, and managing neurological cases. There was little variation within their comments, with financial constraints, patient severity, time pressures, and owner willingness to pursue investigations and treatment influencing their ability to gain experience and learn from the case. Lack of exposure meant fewer opportunities to apply knowledge and skills and make connections. Lack of exposure also reduced comfort and had the potential to create frustration. For example, when asked about areas she struggled with, Emilia (dislikes) discussed disorders seen "less frequently". Calia (enjoys) also noted that, "if you don't use it, you lose it. But, um, that does make it always feel like I'm starting from zero and... makes the... uphill... the steepness of the climb a bit steeper".

Repeated lack of exposure could feed into a negative spiral of low confidence, stress, and expectations of failure if the veterinarian did not engage in feedback or take the opportunity to become involved in any referral investigation and treatment. Fear of failure and reluctance to show weakness could lead to participants avoiding exposure to cases and subjects they felt uncomfortable with. For example, as noted previously, when discussing continuing education Grace noted that she would not choose to upskill in neurology if other options were available “because I would be worried that... I would start the course and just be hopeless at it”.

Sienna’s (dislikes) reflection on her lack of comfort with neurology revealed that “back then I felt like I had to present... I knew everything. ‘No, I'm fine’” even though she expressed self-blame when making mistakes. Although speaking more generally, James (indifferent) expressed “apprehension” at times when approaching specialists and Mel (dislikes) noted how “you don’t want to feel stupid in front of them”. Such comments suggested that reluctance to show weakness could also result in veterinarians failing to seek help when needed, adding stress and discomfort to their experiences. In turn, exposure to uncomfortable cases could either reduce or aggravate fear of failure and reluctance to show weakness, depending on the context and outcome of those experiences.

In summary, exposure had the potential to create confidence, understanding and positive perspectives of neurology when there was opportunity to work through clinical cases calmly and systematically. When conditions were suboptimal, exposure to neurological cases risked exacerbating negative perspectives of neurology through stress, panic and low confidence.

4.3.5 Values and Traits

> “One person’s ceiling is another person’s floor.” (Grace, avoids)

The theme of Values and Traits referred to aspects of an individual’s professional and personal life that were considered of importance. Values and Traits included personality traits and beliefs. Beliefs were personal, based on social or cultural tenets, or contextual and situation specific. Discussions of clinical experiences highlighted participants’ values and traits in two ways. Firstly, participants explicitly discussed what was important to them and the personality traits they saw in themselves. Secondly, values and traits were implicitly highlighted by frequently repeated and emphasised topics during the interview.

The influence of values on perspectives of neurology depended on what participants valued, and how much it was valued. Values could therefore act as push-pull factors. Context also affected whether it was possible to uphold values, which in turn risked flow-on effects into other themes. For example, failure often promoted desire to learn amongst individuals with drive to improve oneself, but triggered strategies for failure avoidance amongst those with fear of failure.

Values and personality traits are usually stable. An adult's personality changes little over time and typically becomes more consistent with maturity (Caspi et al., 2005). Similarly, fundamental values tend to remain stable, although expression of those values can be modified based on personal experiences (Hoogland, 2015; Vecchione et al., 2016). Therefore, values and personality traits influenced participants' perspectives of non-neurological disciplines in similar ways to which they influenced perspectives of neurology.

Values and Traits was the largest theme that emerged from the data in terms of the number of coded comments. Six thematic elements emerged from participants' expressions of their values: Drive to Help Others, Intellectual Challenge, Self-belief and Drive to Improve, Tolerance of Uncertainty, Systematic Approach, and Need for Validation.

4.3.5.1 Drive to Help Others

The thematic element Drive to Help Others refers to participants' desire to help animals and people. Drive to Help Others included the contextual value the participant placed on life and emotional connection to others.

All participants spoke of the desire to help others and affective responses to this desire, whether speaking of themselves or others. However, the relative importance of this value differed. For Sara (avoids), Emilia and Sienna (both dislikes), and James (indifferent), emotional associations with patients and owners featured frequently and early in discussion of their experiences. In contrast, Jenson, Max and Michael (all enjoys) focused more on intellectual aspects of neurological cases, with only a short discussion of their affective responses to helping others, almost as an afterthought. For example, when recalling a neurological case, Michael primarily discussed how "sleuthing down to [the diagnosis] was super interesting". With further prompting he noted that the dog's pain had been the reason why the case was recalled, and that he "really felt sad for that dog and really wanted to help him". However, in the next sentence Michael moved on to discuss enjoyment of "process elimination" and the patterns of neurology, suggesting that although helping others was valued, intellectual stimulation was valued more highly in such cases.

Inability to act when driven to help others could take a high emotional toll. Resultant feelings included frustration, anxiety, panic, feeling "guilty" (Jenson, enjoys), and the perception they were "helpless"

(Heidi, indifferent). Comments from Charlie (enjoys) suggested such feelings could lead to mental and emotional exhaustion, and were echoed by both Heidi's (indifferent) and Sara's (avoids) need to alter their career path away from an area of practice they found overly emotionally demanding. However, the level of affective response depended on the degree of both internal and external pressures the individual felt to achieve a positive outcome. These were in turn influenced by the relative value of life, degree of alignment of client and veterinarian goals, and the focus of the desire to help.

The relative value of life

The relative value and type of value placed on an animal's life influenced the type and level of participants' affective response to neurological cases. While all participants clearly cared about their patients, production animal veterinarians (Sara and Zoe (both avoids) and Jack (dislikes)) were more pragmatic regarding the limitations of investigation and treatment of neurological disease. Animals had financial rather than emotional value and, as Sara noted "normal production animals are not destined to live out to their full life expectancy. So … cutting a life short, it's not difficult". In contrast, higher emotional value placed on small animals created more emotionally demanding and stressful situations.

Veterinarians in small animal practice were considered subject to greater expectations from owners, and outcomes were typically considered of higher stakes due to the level of emotional investment. As Grace (avoids) noted for some owners, "they'd do it for their child, they'll do it for their dog". Sara (avoids), Lisa and Jack (both dislikes), Heidi (indifferent), and Charlie (enjoys) also discussed high client expectations and the resultant pressure on veterinarians to meet those expectations. Lisa described how "the owners are like, 'but this is like, a one-year-old dog, like, how can it be ill? It's all fine otherwise. You have to find me a cause. Like, anything'". The need to achieve diagnoses and prognoses was acknowledged by almost all participants. This created potential emotional conflict between perceived need to help and ability to help due to financial constraints and lack of answers, treatment options and concrete prognoses for neurological diseases.

Alignment between client and veterinarian expectations influences affective responses

> "She loved being wheeled out, like, feeling like a dog... that– that stuff. Ah... and... and I remember putting– we put a– the owner sent us a picture of how she was before. So I put that picture in her cage, like, this is what we were going for. (Laughs.) And, ah, we want this dog to fetch the ball one day. And she did - in the end, she did. … I think [the

> reason she came to mind] was mostly... the care, that we did for her. She did– she required a lot of care. She required like a one-on-one, somebody sitting with her for the first, I'd say 72 hours, at least. Like... like, she was anaesthetised. … Also, like, getting her and putting her on the trolley and to wheel her out, that was like a mission. That were like four people, four or five people involved every time. And nobody ever... everybody was just on board, just went for it... straight away, like nobody questioned it and was like, 'oh, no, not again'. And the dedication of the owner... Like, obviously they had... had no financial limitations, which helps. But … some owners... would have money, would– just wouldn't want to spend it. And mostly I find the owners... often don't... just can't deal with the emotional side of this. It's like, when you explain to them, this is going to be a long game, and in the end, you might not... have a walking dog, you know. Um, but they were on board and they're like, 'oh, as long as she recognises us'."
>
> (Tessa, indifferent)

As per Tessa's comments above, some participants highlighted owner reactions to their pet's neurological disease as reasons why a case came quickly to mind. Responses were predominantly positive, relating to owner dedication to their pet's recovery: "what was really motivating was that the owners were so sweet, and they weren't, um, particularly affluent, but they were trying so hard, and that dog was so well-loved, and he was also such a dear" (Calia, enjoys). When participants were heavily invested in patient care and outcomes proved positive, feelings of success were amplified as participants could see their own contribution to the outcome.

However, negative owner interactions, such as mismatch between owner and veterinarian expectations, were also raised. For example, people may have different perspectives of what constitutes a positive outcome, with these perspectives dependent on what is realistic and what is desired. Grace (avoids) recounted how deflated she felt when one owner trivialised what she had perceived to be a great outcome, turning feelings of satisfaction and success into disappointment.

Differing desired outcomes, or perceptions of what is realistically achievable, could lead to misalignment of client and veterinarian objectives and create internal conflict. Like Grace, Sara (avoids) and Lisa (dislikes), Heidi (indifferent), and Calia and Jenson (enjoys) also discussed the potential for affective difficulties from such scenarios. In some situations, such as disagreements over perceptions of welfare, that conflict might be impossible to resolve. Negative interactions with clients could lead to emotional deflation at best and disillusionment, feelings of failure, and self-recrimination at worst.

> "You may have owners that totally accept that [the outcome was never guaranteed], and … you have owners that... don't understand, and they, ah... they want, or they need, to blame someone. Because sometimes you need to blame someone to feel yourself better, which obviously is totally wrong. And– and they blame you, and– and they think that you have done something wrong. … If you are not strong enough on those, you get back home and you blame yourself, and– and you blame yourself that you have made a family so unhappy, and– and it– it just mentally destroys you." (Charlie, enjoys)

The focus of the desire to help

Participants with a high drive to help others could still feel success when case outcomes were negative. Sara (avoids), Sienna (dislikes), Wes, James and Holly (all indifferent), and Charlie (enjoys) all expressed how satisfaction could be derived from showing respect for the patient and client and doing their best to meet the client's true needs. In these situations, participants sometimes adjusted their own clinical aims and definitive answers became less important as the relationship with the client provided reward. James summarised this when discussing oncology cases: "it's not just a business. … You make these relationships, you know. And …it's usually not going to have a super-happy ending but at least they know they did everything". Similarly, Wes noted "the end result of the patient isn't always what's going to make... the person the happiest".

Discussions around helping others also extended to non-clinical situations. Participants described their desire to improve clients' overall experiences, teach and help others understand, inspire, motivate, and provide support:

> "As a student and as an intern, I definitely didn't feel... like I knew what I was doing … And so that's … my goal... being here teaching … to try to impart that to them so then when they walked out the door... they may not have known everything, but they at least knew how to deal with those patients." (Tessa, indifferent)

Many other participants, including Sienna and Jack (both dislikes), James, Heidi, and Wes (all indifferent), and Charlie and Michael (both enjoys) also emphasised their desire to help students avoid the mistakes they had made and pitfalls they had encountered.

In summary, drive to help others had the potential to create powerful affective responses, depending on the levels of internal and external pressures the individual felt to achieve a positive outcome. Although positive affective responses were often discussed, the language used to describe negative affective responses was typically stronger. The nature of what was perceived to be a positive outcome and the level of drive to help others differed between individuals. Therefore, drive to help others could potentially have a large or small effect on an individual's perspective of neurology and was highly context dependent.

With regards to neurology, participants who focused more on ways they could help beyond just case outcome tended to have more positive perspectives of neurology. Additionally, participants with lower drive to help others tended towards more positive perspectives of neurology. In contrast, participants with a high drive to help others and who primarily focused on positive case outcome tended to dislike/avoid neurology.

4.3.5.2 Intellectual Challenge

The element Intellectual Challenge refers to participants' enjoyment of learning and need to be challenged. Intellectual Challenge included differences in response to challenge for a variety of outcome goals.

Contextual enjoyment of challenge

Almost all participants discussed intellectual challenge, but the value placed on intellectual challenge differed according to context.

Some participants, including Tessa and Wes (both indifferent), and Calia (enjoys), needed almost constant intellectual challenge; lack of intellectual challenge tended to reduce satisfaction or result in boredom. For example, Tessa discussed her "need to go back to academia now. It's just pointless being in private practice" after noting how she was "bored" and acknowledging her drive to repeatedly pursue new learning opportunities. Wes similarly "realised that general practice was really going to bore" him and sought disciplines and working environments that were more likely to challenge him.

Some participants appeared to use intellectual challenge to prove their worth and abilities to others and themselves. For example, Michael (enjoys) enjoyed the "prestige thing … I want something difficult”, while Holly (indifferent) “hated” expensive investigations and found satisfaction proving she could manage with a “bare bones approach”, using “creative solutions”.

Some participants, such as Jack (dislikes, but initially enjoyed), Heidi and James (both indifferent), and Max, Charlie and Jenson (all enjoys), used intellectual challenge as a driver to improve their knowledge and abilities. James’ difficulty achieving answers did not re-invoke negative perspectives and instead was “quite the opposite”, encouraging him to learn more. Similarly, Max spoke of the “audit” he would undertake, “you had to justify everything ... And because you had to justify things, you learnt”.

Finally, comments from other participants, such as Zoe and Grace (both avoids), and Sienna and Mel (both dislikes), suggested intellectual challenge was only enjoyed under specific conditions. For example, contexts in which the participant had pre-existing interest or a reasonable level of confidence that success would come quickly, there was little uncertainty, stakes were not high, or a successful outcome was valued. Zoe even commented on this contextual effect. After discussing how she enjoyed the complexity of her preferred discipline, she reflected “that's kind of contradictory, isn't it, because I don't like neuro because it's too complex and I don't understand it”.

Satisfaction in success: the influence of effort expenditure and the value of challenge

Enjoyment of intellectual challenge and the effort expended to achieve success were linked to motivation (see Section 4.3.3), and self-belief (Section 4.3.5.3) and tolerance of uncertainty (Section 4.3.5.4). Success in attaining one’s goal in situations of intellectual challenge was associated with satisfaction, positivity, and increased self-belief. James (indifferent) spoke of “moment[s] of discovery” with neurological cases that made him more optimistic. Subsequent situations in which he was “doing everything you're supposed to do and still not... getting closer” galvanised his desire to learn more and improve his understanding of neurology.

Success after effort or moments of discovery was typically viewed as rewarding (promoting motivation). Success was earned, and participants seemed proud of their achievement (upholding values). In contrast, success despite low effort had variable effects on perspectives of both neurology and non-neurological disciplines. Sara (avoids) and Mel (dislikes) explicitly preferred easy solutions as these were often associated with rapid resolution and a lack of ongoing self-questioning. Mel enjoyed “easy surgeries” which provided “immediate gratification” and validation through the feeling that “you physically, yourself, have altered the animal. Hopefully, for the better”. Other participants, such as Tessa (indifferent) and Calia (enjoys), viewed easy success as unrewarding, and easy success had no appreciable influence on their future motivation, or values such as self-belief and drive to improve (see Section 4.3.5.3). For these individuals, success and subsequent motivation required challenge. As Calia noted, "I prefer it when things are uphill … like being bored is– is really annoying to me. I think I do anything to not be bored".

Enjoyment from the process of intellectual challenge *versus* finding an answer

The lens through which intellectual challenge was viewed varied. When discussing intellectual challenge, Sara, Zoe and Grace (avoids), and Mel and Emilia (dislikes) focused on a primary goal of finding the right answer. This primary goal tended to be emphasised and linked to affective responses, for example, Mel found the "more frustrating types of cases would be... when you don't get a specific diagnosis", later going on to say, "I don't like not having the answers, and like 'oh, it could be this, this or this'", and later still, "if I don't know the answer... that's when I'm slightly less happy".

For other participants the focus was on improving understanding and the ability to make sense of data ("something that makes it quite cool is that we don't know everything yet", Calia, enjoys), or finding alternative answers ("it's not a one-size-fits-all type of thing … there's tinkering that goes on", James, indifferent). Participants wanting to improve seemed to focus more on the process of intellectual challenge rather than reaching the outcome, with Max (enjoys) even voicing this: "the treatment and then getting the response is really great, but I think I get much more fun out of the diagnosis".

A focus on outcome *versus* the process of challenge: effects on how failure is viewed

Differences in the focus of intellectual challenge appeared pivotal in the development of affective responses to failure during intellectual challenge. Sara and Grace (both avoids) and Sienna (dislikes) discussed a focus on finding the right answer, but also dwelt on the negative effects of failure, including frustration, self-recrimination and, potentially, guilt.

In contrast, participants who focused on the process of intellectual challenge often saw failure as a temporary setback. For example, Holly (indifferent) enjoyed the process of finding "creative solutions" that maximised outcome from different skills and minimal resources. Failure to find one solution did not mean overall failure, as "thinking this is plan A, and OK, we're now down to plan E" (Holly) was part of the process. Similarly, Tessa and James (both indifferent) both alluded to how clinical failures were context-dependent, while Heidi (indifferent) mused on how setbacks could lead to positive discoveries.

Individuals’ reactions to intellectual challenge could therefore be influenced by their desire to help others (Section 4.3.5.1), self-belief and drive to improve (Section 4.3.5.3), and source of validation (Section 4.3.5.6).

The dynamic nature of focus in intellectual challenge

Importantly, the personal focus of intellectual challenge was not necessarily fixed. As perspectives changed, so could the meaning of success. As a new graduate, Sienna (dislikes) had been very focused on getting the right answer. Difficulty reaching a definitive diagnosis would lead to feelings of failure, causing her to question her professional worth (see Box 4.2 for examples). Over time her focus became less fixed on the answer, and she embraced the process of clinical reasoning to explore cases: “I really enjoy … the process of working it out … with the information you have … logically working things out, and what does and doesn't fit …. I know it doesn't always work like that, but … often it does” (Sienna). By shifting her focus from specific answers to logical explanations, Sienna was able to achieve greater feelings of success and avoid some of the negative emotions associated with difficulty reaching a definitive diagnosis in veterinary medicine.

In summary, enjoyment of intellectual challenge was contextual with some participants only enjoying challenge under specific conditions. Participants were typically less susceptible to strong or prolonged negative emotional effects of failure when they obtained enjoyment from the process of intellectual challenge rather than finding an answer. The effects of intellectual challenge on perspectives of neurology were therefore also contextual but had the potential to change over time.

4.3.5.3 Self-belief and Drive to Improve

The element Self-belief and Drive to Improve refers to participants’ resilience and effects on motivation and perception of self in response to perceived failure.

Motivation from failure

Participants’ comments indicated that self-belief could be contextual, learning from mistakes could be active or passive, and improvement was, to an extent, dependent on reflection.

Participants discussed or alluded to self-belief and resilience in a variety of contexts. These included non-clinical professional, sport-related, and personal contexts, as well as veterinary learning and skills.

Zoe (avoids), Tessa and Holly (indifferent), and Michael and Max (both enjoys) seemed to express self-belief in all aspects of life. However, self-belief and resilience were clearly contextual for other participants, such as Grace (avoids), Sienna and Mel (both dislikes), and Heidi (indifferent). Grace's experiences demonstrated considerable resilience in multiple sectors, both personal and professional. Grace spoke several times of her reluctance to give in, but her resilience appeared primarily associated with situations that had little effect on others, were last-ditch efforts or that she had little control over. In comparison, she had low self-confidence when making high stakes decisions that would affect others, was fearful of being wrong or making mistakes, and expressed "that … feeling of inadequacy and that you will be exposed as being inadequate because you don't know what's wrong with their animal" (Grace). Grace went on to say, "it's the things that I can make a– that would make a difference. So, misdiagno– or being distracted by the broken leg and missing the nerve damage. Um. Yeah. ... It's missing something that would be a deal breaker". It seemed that Grace even avoided using the word misdiagnosis, changing the direction of her sentence as if to justify mistakes before admitting to the potential to make them. Similarly, she started to explain how her preference for avoidance resulted from the feeling "that I would f–", changing the sentence direction away from the word fail to "just be[ing] hopeless at it". Like Grace, Sienna, Heidi and Mel also referenced concern over others' judgements which potentially limited their growth in certain areas.

Continual learning, learning from experiences and learning from mistakes or failure were commonly discussed by participants. However, there appeared to be a difference in how these were perceived, particularly for learning from mistakes or failure. Charlie (enjoys) noted, when speaking of others, that "experience doesn't mean that they are better", suggesting that it is not the experience itself but what that experience promotes that is important. For some participants learning from mistakes or failure was simply a necessity, using knowledge of the outcome of one experience to hopefully avoid a similar situation in future. While considered "useful" (Sienna, dislikes), this appeared to be a passive form of learning from mistakes or failure, focusing on avoidance of the same mistakes. In part, this may have been associated with unwillingness to expose one's failure to others' scrutiny: "I'm much better about asking for help and admitting when I don't know things, whereas back then I felt like I had to present... I knew everything" (Sienna). In contrast, other participants adopted an active approach, using mistakes and failure as motivators to improve understanding and skills. These participants embraced difficult situations rather than avoiding them: "up to … a certain point that frustration motivates you to do more" (Calia, enjoys).

Active approaches to learning from mistakes and failure were best exemplified by James (indifferent) and Charlie (enjoys). Both actively sought out learning opportunities, clinical exposure and feedback to improve their knowledge and abilities. Both were comfortable acknowledging their limitations, without fear of judgement. Both were strongly motivated by a desire to minimise future feelings of discomfort by addressing their perceived deficits in understanding, knowledge, and ability.

> "I didn't know what I was seeing … So I found it extremely frustrating to the point that I... I decided that I had to do something else. I could not do that for the rest of my life because … I just had... that personal... frustration … [of] not doing a good job. … I went to talk to [an internal medicine specialist] and then he mentioned, um, the... internship, which at that time I didn't have an idea what [that was]. So, I went and did, um, ah, an interview for the University … which was the only place where you could get, um, an internship. And I didn't get the position. … But, um, then I decided I still want[ed] to do it. So I studied … for another year because at that time you had [to do] an exam … to get access to the position of the internship. … I studied things that I never thought I would go back to study. And then I went back and applied … and I got it. And then... that changed my life from a veterinary point of view. … When you leave the university, it is up to you. It is up to you how much you want to learn. It is up to you how much you question yourself. It is up to you how much you reflect about the cases."
>
> (Charlie, enjoys)

A drive to improve understanding was evident for not only James and Charlie, but also Lisa (dislikes), Heidi (indifferent) and Max and Michael (both enjoys), all participants who frequently returned to their need to understand the "why" behind one's actions. It is important to note that understanding "why" did not equate to the need for a definitive diagnosis, but rather an understanding of clinical reasoning and process. Michael commented that he'd "never, ever liked anything that just kind of, 'oh, this is dogma, and this is what– this is just how it is'", before going on to talk about his learning: "they're like, 'you're going too– too deep into it'. And I'm like, 'yeah, but I need to know why. I want to know why'". Although they valued learning from experience, these participants argued that this also risked complacency and repetition and did not necessarily advance learning unless you questioned yourself. Lisa summed this nicely by her references to "dinosaur vets" who simply stuck to the same script when faced with similar cases.

Charlie (enjoys) was one of the participants who discussed the importance of reflection on action, whether the outcome was positive or negative. Charlie argued that without reflection, one could not improve: "that is what is going to make you a better ... general practitioner, and that is what is going to make you feel better the next time you find... a similar case". She went on to say, "if someone tells you, 'Oh, I always do that'. 'Why?' 'Oh, I always do this, and it goes well.' Pfft. Get away from that"

(Charlie). Although Calia (enjoys) did not reference reflection directly, she spoke of the importance of the scientific trial and error approach and use of hypotheses to develop understanding, "because there was always a point where we didn't know something … I feel like we have to keep at it because that's the only way we can move forward" (Calia).

The need for expenditure of effort to be valued

Drive to improve was not just based confidence in one's ability to improve, but also effort. Participants therefore had to see the value in expending that effort. When discussing her lack of understanding of neurology, Zoe (avoids) noted "I'm not stupid, you know. I know that if I tried to learn it, I'd be fine, but I just... don't... have the motivation to even try". Drive to improve is therefore, in part, dependent on motivation even when failure is not encountered. If motivation is lacking, there is less drive to improve in that context and exposure to learning opportunities may suffer.

In summary, self-belief and drive to improve primarily influenced perspectives of neurology by channelling failure into motivation, but for some participants was context-specific and dependent on the relative strengths of other values and personality traits, and motivation. Reduced self-belief and drive to improve risked failure avoidance and reduced exposure to neurology learning opportunities that might have influenced perspectives of neurology.

4.3.5.4 Tolerance of Uncertainty

The element Tolerance of Uncertainty refers to participants' level of comfort when dealing with the unknown. Tolerance of Uncertainty was therefore associated with Section 4.3.5.2 Intellectual Challenge, Section 4.3.5.3 Self-belief and Drive to Improve, and participants' level of reliance on visibility.

All participants, regardless of their attitude towards neurology, preferred to find answers. Certainty increased confidence in one's actions and allowed participants to shift their focus onto their next task:

> "There's so many things that can affect... the brain and cause seizures. You know, it could be in the brain, it could be outside the brain... um, whereas a wound is a wound, you know? … If your kidney's poking out, that's fine - just clean it and poke it back in. (Laughs.)" (Emilia, dislikes)

> "I do like surgeries … You kind of do it and it's done, there's no– there's no mystery at the end of it all, there's no... uncertainty that you don't know quite what you're dealing with."
>
> (Mel, dislikes)

> "Like surgery, you open the animal and... right there you can... you know, you know exactly what's going on. You have the answers. And … radiology, you have the answers. You go in and you see either through ultrasound or through radiograph, 'well, there's a problem, there's an issue' or 'no, there is not– no problem. There is nothing that we can see radiographically, have fun medicine'." (Michael, enjoys)

Certainty could also aid retrospective learning, as Sara (avoids), Wes (indifferent) and Max (enjoys) specifically noted when discussing post-mortem investigations. Sara even considered "sometimes success [is] where the case that you euthanase and then being able to... hopefully do a post-mortem and being able to get an answer to it".

However, uncertainty is common in veterinary medicine. Financial constraints, client wishes and diagnostic limitations all potentially hinder veterinarians from gaining answers. Affective responses to uncertainty in a veterinary context, and the intensity of those responses, differed between participants.

Participants suggested that new graduates did not expect the level of uncertainty they encountered in the everyday work of the profession. Most case examples used in undergraduate teaching ended in definitive diagnoses, which could subconsciously create the expectation of finding an answer for every case. This expectation risked new graduates feeling unprepared, stressed, and a bad vet if they failed to find the answer. Mel (dislikes) described how she had expected her undergraduate training would "turn [her] into a superhero", while Grace (avoids) spoke of students' feelings of fear, inadequacy and being "out of their depth" which in turn posed risks to self-worth and mental health. Lisa and Sienna (both dislikes) and Charlie (enjoys) described new graduate experiences of panic associated with uncertainty triggered by encountering neurological cases. Lisa was "pretty freaked out … I was very much like, what the hell do I do?", while Charlie felt lost thinking the patient was going to die and Sienna questioned whether she was truly qualified to be a veterinarian. James (indifferent) also acknowledged the mental toll that uncertainty could take, noting that "it takes a huge chunk out of you, you know, 'well I'm supposed to know this'". Neurology was generally seen as a discipline in which uncertainty was particularly inherent: a discipline that "never has an answer" and "is a big unknown" (Lisa, dislikes), is "nebulous" (James, indifferent),"the way it manifests can be highly variable" (Zoe, avoids), in which “you’re limited every which way you turn” (Calia, enjoys) and “in neurology, either cases go very, very well or they can do it [sic] very, very badly” (Jenson, enjoys). Uncertainty arose from a lack of understanding, and difficulty obtaining definitive diagnoses and prognoses.

Affective discomfort in situations of uncertainty

Participants with a negative attitude towards neurology tended to express affective discomfort with uncertainty. Sara and Grace (both avoids) and Mel (dislikes) made their dislike of uncertainty explicit. They discussed enjoying “easy” cases, cases that were quickly resolved, and situations in which the diagnosis and appropriate course of action were clear. Grace termed this “the treat and street. Yeah. Come in, have your treatment (taps the table), go home again”. Both Grace (avoids) and Emilia (dislikes) discussed the influence of time constraints on inability to resolve uncertainty, and the negative effects this had on their willingness to see and manage neurological cases. Emilia described cases that need immediate action as “the ones [she] like[d] least” due to uncertainty over whether the action taken was appropriate. In contrast, cases in which she had more time were “the ones that [she] like[d] better”, “because you've actually got time to... I need time to look first (laughs), set it out in my mind and go through [the step-by-step process]”.

For these participants, and Sienna (dislikes), uncertainty limited the potential for mental closure and risked on-going self-questioning. Mel enjoyed cases in which “you kind of do it and it's done, there's no– there's no mystery at the end of it all, there's no... uncertainty that you don't know quite what you're dealing with”. Grace spoke of her “feeling of fear and inadequacy” and the effects that feeling “out of [your] depth” could have on “mental health … and [your] sense of self-worth and– and self-doubts and things like that”. Sara “like[d] absolutes” and disliked situations that could not be resolved within the time of the consultation, with her comments suggesting the difficulty related to lack of control over the outcome:

> “[I] miss calving cows, um, because no matter how bad, or smelly, or revolting it was, um... you got an outcome. So at the end of the call, usually, um, you had either fixed it or euthanased the cow. Um, so I liked the certainty around, um, an outcome, and that the job was done. So, contrasting that with down cows where, um, it would be... less than 50 percent of the time that, when you finish the call... that... it's better or dead. There was, you know, kind of a– a walking away, knowing that you were leaving it up to the nursing care of the farmer and their staff and, um, and also it was quite difficult to predict the outcome because some of the down cows you thought "oh yeah, she'll be fine, she'll be up in two hours"... died. And some of the ones that you thought were pretty bad and you

> thought... "mmm, think it's a slim chance" and they might get better."
>
> (Sara, avoids)

Sara and Mel also appeared to link certainty to their perception of their professional identity; it was important to them to be certain they had completed their perceived veterinary responsibility to the patient and owner. For example, Sara described satisfaction in calving because even with a stillbirth "that was still seen as a... a win because you... your job is to get the calf out and you did". James provided a possible explanation for how uncertainty could challenge professional identity:

> "We're supposed to know. And I know, I know, I know, but that's– that's just what we think, and we're– we're supposed to know all this stuff. We're taught it all in school, we're supposed to know... we're supposed to be a Jack of all trades."
>
> (James, indifferent)

Uncertainty could also aggravate one's fear of mistakes or failure. Sara, Grace, Mel, Sienna, Lisa and Emilia all disliked or avoided neurology and preferred disciplines in which they could physically see the underlying pathology or in which there was a clear step-by-step process to be followed. A clear diagnosis typically meant treatment options were also clear. Even if prognosis was uncertain, it was mentally and practically easier for these participants to manage owner expectations if they were confident in their diagnosis.

Because uncertainty affected owners' as well as veterinarians' decisions, there was the potential for anxiety over inability to provide concrete guidance, especially amongst participants with a high drive to help others. Owners needed to deal with the consequences of their pet's disease and financial outlay was often high. Grace (avoids) repeatedly noted the stress and self-blame that could result from "missing something that would be a deal breaker", particularly when there had already been considerable financial investment from the owner. For her, simply the possibility of missing a significant finding caused anxiety. Jenson (enjoys) also discussed the potential for feelings of guilt when expensive tests did not provide the answers needed. Several participants, including Lisa (dislikes), James (indifferent), Max (enjoys) and Charlie (enjoys), noted that many owners had difficulty understanding disciplines such as neurology, in which pathology was less visible but its manifestations could be severe. Seizures and vestibular dysfunction were mentioned by multiple participants, while Max described how "the sudden onset of paralysis is always difficult for owners to comprehend because it can be so many different causes", and James explained how difficult it was for owners to relate a loss of withdrawal versus, for example, ocular disease. Uncertainty could therefore risk the relationship between clients and veterinarians, through difficulty obtaining answers, misinterpretations and the need for owners to “just trust [the vet]” (Max), creating an additional source of stress.

Reducing affective discomfort in situations of uncertainty

Participants with a more positive attitude towards neurology also discussed difficulties arising from the uncertainty of diagnoses, treatments, and prognoses. However, these participants seemed more accepting of uncertainty, with Calia (enjoys) noting that “even if we know what to do, we can't always do what we'd like … it's not just about things we don't know, but it's also about trying to find creative solutions”. Participants with a more positive attitude towards neurology also appeared better able to manage uncertainty than participants with negative attitudes towards neurology. James (indifferent), and Charlie, Max, Michael, and Jenson (all enjoys) tended to use neuroanatomical pathways and fundamental principles of neurology to mentally visualise and make sense of the nervous system, meaning less reliance on physical visibility. The neurological system was considered “just so logical” (Max) and “drawing … pathways” (Charlie) provided a visual representation of unseen processes. Similar statements were also made by Jack, who had previously enjoyed learning neurology even though he had become disenchanted after graduation. He was able to manage uncertainty because “it all just kind of ties together really nicely”. These participants, along with Wes, Holly, Tessa and Heidi (all indifferent), seemed to mitigate uncertainty through clinical reasoning and a systematic “more organised approach” (Holly). Furthermore, such participants seemed more comfortable, and perhaps had better strategies, managing owner expectations and the veterinarian-client relationship even when answers were not available (“you always try to– to put things in a more beautiful way”, Jenson).

In summary, tolerance of uncertainty was typically associated with more positive perspectives of neurology, and vice versa. This tolerance primarily arose by finding a degree of certainty through processes of logical thinking and applying knowledge of fundamental neurological principles. Participants with lower tolerance of uncertainty often preferred disciplines with clear and directly visible associations between pathology, clinical signs, and treatment options. Neurology was regarded as a discipline in which uncertainty was particularly inherent, which created difficulty for individuals with low tolerance of uncertainty.

4.3.5.5 Systematic Approach

The element Systematic Approach refers to the importance participants placed on, and their tendency to adopt, systematic approaches to different situations. Systematic Approach included how systematic approaches are used in clinical and learning scenarios.

All participants referenced the importance of a systematic approach when dealing with veterinary cases, particularly when the situation was complex. In general, systematic approaches were associated with positive affective responses. Participants felt a systematic approach could guide actions even when understanding was lacking, typically reduced the risk of mistakes, allowed early detection of complications, provided a degree of certainty that increased participants' confidence in their actions, and could help calm emotions, especially in emergency situations.

Having a clear systematic approach to follow was critical in Sienna's (dislikes) enjoyment of cases and learning (see below). Wes (indifferent) voiced a similar preference, believing "that's the best way I learn … when it's presented in a very... unilateral format … I find that quite easy to follow", and Grace (avoids) was "so excited" whenever she found an algorithm to follow. Lisa (dislikes), Tessa and Holly (both indifferent), and Max and Michael (both enjoys) also discussed systematic approaches when discussing enjoyed disciplines. Conversely, having no clear systematic approach to follow could cause confusion, anxiety, self-doubt, and panic.

> "What made me so comfortable about [my favourite discipline], like right from the get–go … it was because I felt like I had a... structured approach to those cases. I– even though I wouldn't always get the right answer, I didn't always know what the answer would be, … I could work through them in a logical way and get to a, sort of, semi-list of, you know, what might be likely and where I was going to go next. Whereas with neuro stuff, and orthopedics were the same to be honest, I didn't– I just felt like I was flailing wildly, it's like 'it's neurological! Argh!' (Laughs.) That sort of, um, I don't know, I don't have a logical series of steps to work through." (Sienna, dislikes)

Participants frequently noted a systematic approach was necessary if one was to successfully perform and interpret the neurological examination. The importance placed on thoroughness differed. While Jenson (enjoys) spoke of the need to "be complete" and not "take any… any short ways", Tessa (indifferent) acknowledged her tendency to skip steps and miss clinical findings but also her ability to remain focused on "the neurology that gets me to the diagnostics I need".

For some participants, understanding the nervous system was not always necessary provided they had a clear step-by-step guide to interpreting their examination findings. A systematic approach could therefore offset a lack of connections between theoretical knowledge and the clinical manifestations of neurological disease: “if you … think, ‘oh right, I can't quite remember... how that goes’, you can just refer back” (Emilia, dislikes).

However, several participants with more positive attitudes towards neurology noted that connections and use of logic were still important. Heidi and Tessa (both indifferent) and Charlie (enjoys), in particular, discussed how mistakes could result from over-reliance on method without thinking about what you were doing and why, “because unfortunately, with neuro, they... come with a variety of diseases, but present kind of similarly” (Tessa). Students’ tendency to focus only on method over patient considerations was specifically raised, particularly in relation to trauma: “doing a full neurological exam on an unstable patient” (Tessa), “when you don't know if, you know, they have a spinal fracture at that point” (Heidi), “you would manipulate that dog totally different[ly]” (Charlie). Heidi also described personal experiences of near misses in which singular focus on a systematic rather than patient-oriented approach risked ignoring or failing to recognise the importance of discrepancies.

The usefulness of a systematic approach was therefore, to some extent, dependent on the level of understanding of the theory underpinning that approach. When methods were obtained from an external source, some participants simply followed the approach without necessarily understanding or questioning it. This risked confusion and frustration when the case went off-script. Other participants, such as Tessa and James (both indifferent), and Max and Charlie (both enjoys), either adapted the approach they were given or created alternatives (when necessary or to better suit their needs). These latter participants tended to base their approaches on logic and reflection in-action, and coped better when cases did not go as expected. Tessa stated that “panicking about it and going, like, all over the show is not going to help the animal”, going on to say how being unable to fully examine a patient simply meant “you have to kind of... tease out the... information that is going to sway you in one direction of treatment or the other”.

In summary, systematic approaches increased comfort and confidence and reduced confusion and uncertainty, both in relation to neurology and other clinical disciplines. Perspectives of neurology were therefore influenced by whether the participant had, and could use, a systematic approach to work through the case. However, the benefits of a systematic approach could be limited by the individual’s level of understanding of that approach.

4.3.5.6 Need for Validation

The element Need for Validation refers to participants' need to be seen, or to see themselves, as having done a good job. Need for Validation could be achieved via external or internal perceptions of success.

Measures of success

Participants expressed different meanings of "success" and therefore different ways to gain validation. All participants believed helping the patient and client was of prime importance, but perceptions differed for what level of help constituted success. Participants felt successful when they obtained a definitive diagnosis, when the patient could be discharged with a good quality of life or could fulfil its role or purpose, or when they felt they had done their very best to help the patient and owner. Several participants discussed more than one of these factors when speaking of success.

Obtaining a definitive diagnosis was an explicit measure of success for Mel and Emilia (both dislikes), Max and Michael (both enjoys) and, to some extent, Sara (avoids) and Sienna (dislikes), but others also discussed the importance of answers. Obtaining definitive diagnoses provided answers not only for the veterinarian, but also for the owner and was linked to easy decisions, easier treatment, and easier recognition when the problem had been resolved. "Like an intestinal foreign body, you know, you go in there and cut it out and the animal does fine. I mean, that's a great kind of surgery. A great outcome" (Mel). When a veterinarian's actions contributed to resolution of the problem, there was not only a "sense of achievement" (Sara), but validation. Providing answers could create validation via both external (e.g. from colleagues and owners) and internal sources, and, depending on context, in a general and more personal sense. However, obtaining definitive diagnoses had the narrowest focus of the participants' definitions of success, potentially making it hardest to achieve.

Discharging the patient did not require the problem to be resolved, but simply to be manageable with sufficient quality of life for the animal and client: "as long as she's not in pain or hasn't got any welfare considerations then... that to me is a success" (Jack, dislikes). More emphasis was placed on achieving sufficient clinical improvement so that both the patient and owner were happy, than on obtaining definitive answers. For example, "success for me is– is figuring out a way to keep it comfortable, whether or not we know what the– the diagnosis is" (Holly, indifferent). Achieving this sufficient quality of life defined success for Sara, Zoe and Grace (avoids), Lisa, Jack, and Emilia (dislikes), Heidi and Holly (indifferent), Jenson and Calia (enjoys), and, to some extent, Wes (indifferent). Validation could be achieved via both external and internal sources but there was the potential for mismatch between veterinarian and client perceptions of quality of life (as discussed in Section 4.3.5.1 Drive to

Help Others). In other words, the level of external validation might not match the level of internal validation.

Finally, doing their very best did not require veterinarians to reach definitive answers or the patient to improve to a point at which it could be discharged: “I feel the most satisfaction, and the most successful, when the person leaves the clinic feeling as though we've done everything we can and that they're content that we have” (Wes, indifferent). This was the broadest focus for participants’ definitions of success. Participants who defined success as doing their best, such as Sienna (dislikes), Charlie (enjoys) and, to an extent, Tessa and Wes (both indifferent), tended to also speak of the need to always try to improve. As Charlie noted, “there's always something that you could have done different[ly]”. Being comfortable that they had done their best required reflection to determine if it truly was their best and whether it was possible to remedy their actions to do better in future. For these individuals, validation was primarily internal.

Whether it was their definition of success or not, Sara and Zoe (avoids), Mel, Lisa and Emilia (dislikes), James and Heidi (indifferent), and Max and Jenson (enjoys) spoke of the gratification they felt when they had “fixed” the problem. Such outcomes could be “the best feeling on the planet” (Lisa), “awesome fun” (Mel), and “invigorating” and “very satisfying” (Emilia). But, as discussed with drive to help others (Section 4.3.5.1), success could still be felt when the outcome was euthanasia provided participants believed they had done the best for the patient and owners were accepting and comfortable with the decision and the care they and their pet had received.

External validation from others’ admiration

External validation could also be obtained when an individual was viewed positively by others. Michael (enjoys), and to some extent Sienna (dislikes), discussed enjoyment of external validation that stemmed from others’ admiration. Michael spoke of his interest in disciplines that were seen as “these high pinnacles … I guess not status symbols, but they're more, kind of like, really seen as the rocket scientist kind of thing”. This did not necessarily relate to a particular patient outcome but rather others’ perceptions of their skills in an area perceived to be difficult, important, or “higher status” (Michael).

The influence of "luck" on feelings of validation

External contributors to success, such as the patient improving despite the actions of the veterinarian, appeared to cheapen feelings of success and decreased personal satisfaction with the outcome. When describing such cases, Grace (avoids) was "not particularly proud of them because [she] didn't do anything... special, or, you know, genius". Sara (avoids) also described cases that improved when she did not expect them to, expressing frustration and confusion but no satisfaction. Other veterinarians shared stories of mistakes they had made, in which the patient improved despite their actions. For example, Sienna shared new graduate stories that she still felt "shamefaced" about, even though the clinical outcomes were good. These stories held notes of relief and feelings of luck, but overall the expression of shame and guilt and some humiliation. External contributors to success therefore did not tend to lead to positive perceptions of the experience, even if lessons were learnt.

In summary, Need for Validation reflected measures of perceived success and whether that success had been achieved. Need for Validation influenced satisfaction and self-view, and contributed to feelings of positivity, or negativity, in relation to clinical cases. Therefore, repeated validation could lead to positive perspectives of neurology, while repeated inability to attain validation led to negative perspectives of neurology.

Need for Validation is linked to tolerance of uncertainty (Section 4.3.5.4), as certainty helped confirm the individual was taking the right steps to achieve their goal(s). Need for Validation is also linked to drive to help others (Section 4.3.5.1), as others' opinions can influence whether a goal is perceived to have been achieved. This is especially true for individuals who seek to help others or who judge themselves by how others see them.

4.3.5.7 Links between values

Because each individual expressed multiple values, the ability to uphold a value was often context-driven and dependent on other values. For example, the elements Tolerance of Uncertainty and Self-belief were linked; some individuals could maintain confidence even when faced with uncertainty, while for others confidence was contingent on certainty.

Interactions between values could create a ripple effect, pushing or pulling an individual away from or towards a positive experience. Evaluating again the link between Tolerance of Uncertainty and Self-belief, when individuals relied on systematic approaches the lack of an approach led to uncertainty. Lack of an approach therefore risks decreasing self-belief for individuals that also have low tolerance of uncertainty and for whom self-belief is contingent on certainty. Having a systematic approach to follow can circumvent intolerance of uncertainty, with individuals relying on structure rather than answers to increase confidence in their actions. Structure through a systematic approach can also aid validation for individuals focused on broader outcomes for success than obtaining a definitive diagnosis.

This dynamic interaction between values made it difficult to establish whether a clear cause and effect existed for how values influenced individuals' perspectives of neurology. For example, although fear of mistakes was often heightened in situations that were considered high stakes, the reasons for this varied. Heightened fear of mistakes could be related to a high desire to help others (as exemplified by comments relating to financial concerns and the effects of participants' actions on others), the effects of perfectionism, or the effect of mistakes on self-view, depending on the individual. However, regardless of the exact mechanism, common difficulties encountered in neurology, such as the lack of a clear approach, definitive diagnosis, and prognosis, had the potential to hinder an individual's ability to uphold their values.

4.3.6 Participant differences between attitudes towards neurology

Comparison of participants who had negative attitudes towards neurology and those with more positive attitudes towards neurology identified several points of difference. While not every participant exhibited all of these differences, most participants displayed at least two of the following trends in a way that was consistent with their attitude towards neurology.

4.3.6.1 Participants with negative attitudes towards neurology tended towards greater discussion of affective responses

Affective responses featured more heavily in interviews with participants with negative attitudes towards neurology than those with more positive attitude towards neurology. As well as being discussed more frequently, the language and delivery of comments relating to affective responses tended to be more animated amongst participants with negative attitudes towards neurology. For example, "yes! I'm on top of the world" (Lisa, dislikes) versus "very gratifying" (Jenson, enjoys), "hideous" and "it'd just been crap" (Zoe, avoids) versus "just turn off" (Max, enjoys).

Negative affective responses were not only typically expressed more strongly by participants with negative attitudes towards neurology, but in some cases clearly conveyed fear of failure (e.g. Grace), self-recrimination and reflection onto self-worth (e.g. Sienna), and imposter phenomenon (e.g.

Grace). With the exception of Heidi (discussed below), these responses were not evident in comments from participants with more positive attitudes towards neurology.

In contrast, Holly and Tessa (both indifferent), Jenson, Max and Michael (all enjoys), and Jack (dislikes but previously enjoyed) primarily discussed intellectual factors and focused more on logic and the ordered nature of neurology. References to affective responses tended to be short.

Some participants who had experienced both negative and more positive attitudes towards neurology, such as Charlie (enjoys) and James (indifferent), were more mixed in their comments, with both animated affective responses (e.g. "mentally destroys you", Charlie) and common discussion of intellectual factors (e.g. Charlie choosing to discuss a case because "it's a good clinical case to… apply clinical reasoning").

Although these differences appeared consistent between negative and more positive attitudes towards neurology, other causes of these differences must be acknowledged. Gender differences might also have played a role as most males focused more on intellectual factors and were less animated in their discussion of affective responses. Similarly, cultural and societal differences may have influenced how comments were expressed.

4.3.6.2 Participants with negative attitudes towards neurology had greater difficulty making connections in understanding

Almost all participants expressed difficulty learning neurology and understanding connections at some point. However, these difficulties typically persisted for participants with negative attitudes towards neurology and lessened for those with more positive perspectives of neurology.

Being able to visualise concepts and clinical problems was important in the development of clear links between theoretical concepts and understanding. "Overall, neurology cannot be explained by– by just text" (Charlie, enjoys). Participants who disliked or avoided neurology tended to discuss the need for physical visualisation. Lisa stated, "I love my anatomy, but... not if I can't see it", Emilia described both learning and clinical scenarios in which understanding depended on visualisation, and Sienna discussed how being "not very good spatially" had negatively affected her understanding of disciplines such as orthopaedics and neurology. Michael (enjoys) discussed a colleague's difficulty and dislike of learning less physically visible subjects, stating "she's more of a, 'I need to see this, it needs to be visual, and this is so abstract'". In contrast, participants with more positive attitudes towards neurology would mentally visualise or draw neurological pathways (like Charlie) to create visual connections. Participants such as Max, Michael and Jenson drew on the logic of process, "how one part looks after the other" (Max) rather than needing to physically see the concept or problem, enabling greater understanding of more abstract concepts and connections.

Failure to make connections when dealing with neurological cases had the potential to exacerbate negative perspectives of neurology through effects on affective responses (above). Having but not understanding connections, for example following an algorithm, did not necessarily aid the development of connections, as evident from Mel's, Emilia's and Grace's comments. In contrast, participants with more positive attitudes towards neurology often discussed how exposure to, and support from, others who were interested in neurology, helped guide their learning and helped made connections more explicit.

4.3.6.3 Participants with negative attitudes towards neurology focused more on answers over process and expressed lower tolerance of uncertainty

Greater importance tended to be placed on definitive answers and "absolutes" (Sara) by participants with negative attitudes towards neurology. All participants enjoyed the clarity obtained from definitive diagnoses, but participants who disliked or avoided neurology tended to be more reliant on achieving a definitive answer in order to experience satisfaction. This reliance was explicitly expressed by Mel, Emilia and Sara, while Grace discussed her fear of failure and worry over making wrong decisions. Sienna noted she had similar perceptions early in her career, at the time when her attitude towards neurology was developed, even though she had become more accepting of uncertainty and admitting weakness since switching to a less clinical role "because I didn't feel like I needed to know everything so much".

In contrast, participants with more positive attitudes towards neurology tended to focus more on logic, clinical reasoning and finding solutions rather than definitive answers. Satisfaction and a measure of certainty were gained from, for example, the process of achieving an accurate neurolocalisation rather than a definitive identification of the pathology: "your diagnosis is very rarely based on your physical exam … So 'successful' is, like, knowing that I didn't spend five thousand bucks on tests that the dog didn't need because, you know, it's... peripheral disease, for example" (Tessa, indifferent).

4.3.6.4 Participants with negative attitudes towards neurology saw less relevance in neurology

How much neurology was valued as a discipline depended on its perceived relevance. All three participants with primarily production animal experience disliked or avoided neurology. Perceptions of low relevance negatively affected motivation to understand neurology, with Zoe and Sara both questioning the need to learn concepts that were considered fundamental knowledge by participants who enjoyed neurology. Perceptions of low relevance also decreased satisfaction in management of neurological cases, as evidenced by Zoe describing her reactions to successful outcomes as "eh", "blah" and "not… thrilling".

Although Grace (avoids) perceived neurology as relevant, she also saw less relevance in concepts that were considered fundamental knowledge by participants who enjoyed neurology, explaining "if we don't remember any of it, then I kind of go, what is the point?". In contrast, participants who enjoyed neurology spoke of the importance of such fundamental concepts to create connections between theory and clinical manifestations, with Charlie explaining she "would find it extremely difficult [to teach clinical neurology] if [students] don't have the concepts" of neuroanatomy and neurophysiology.

4.3.6.5 Participants whose attitude did not fit the patterns

Although Heidi was indifferent to neurology, her comments indicated high affective involvement, to the point where emotional exhaustion had driven her to explore disciplines with greater separation between her and the patient and client (e.g. pathology). Furthermore, she expressed tendencies for low self-confidence, fear of failure, the tendency to reflect failure onto her self-worth, and low tolerance of uncertainty:

> "I do really like surgery quite a bit. But I realise now I would be a– I would– I would be a wreck as a surgeon, because I–I wouldn't be able to sleep at night. I'd be sitting there... fretting about every... thing that happened during the day, and maybe I missed something, and maybe something went wrong. I mean, hopefully I'd know it at the time, but yeah, I think I'm too– I'm too highly... um... anxious to be a surgeon. Yeah. Surgeons have to learn to let things go. Yeah. I'm not sure I could do that very well."
>
> (Heidi, indifferent)

Such strong, negative affective responses were otherwise only expressed by participants who disliked or avoided neurology. However, unlike these participants, Heidi had experienced a long working relationship with neurology specialists. It is likely that Heidi's indifferent attitude towards neurology had evolved through confidence gained from increased exposure to neurological cases and being supported through these cases. Additionally, Heidi sought connections to aid her understanding, rather than relying on factual recall. These connections might also have provided her with a greater degree of confidence, based on logic.

Jack's negative attitude towards neurology was at odds with many of his comments during the interview. He displayed many characteristics expressed by participants who enjoyed neurology, consistent with his initial enjoyment of the subject as a student. However, unlike these participants, his subsequent experiences of neurology, and the resultant perception of low relevance, had negatively affected his motivation towards the discipline. The perception of low relevance was the only factor that Jack shared with the pattern displayed by participants who disliked neurology.

4.3.7 Changes in perspectives and attitudes

Amongst my participants, attitudes towards neurology improved for James and Tessa (both indifferent), Charlie (enjoys). and, to a lesser extent, Heidi and Wes (both indifferent). Mel and Emilia (both dislikes) expressed improved perspectives of neurology, but no significant change in their overall attitude towards neurology. Only Jack (dislikes, but enjoyed as an undergraduate student) reported deterioration in attitude towards neurology following graduation.

Changes towards a more positive attitude towards neurology appeared to be motivated by affective responses and ability to confront discomfort, and were dependent on self-belief and drive to improve, and the ability to make connections.

4.3.7.1 Influences on the possibility for change in attitude

Veterinarians I interviewed shared stories that evoked emotions such as shame, humiliation, and guilt. However, there were clear differences in how different individuals reacted to those emotions. James (indifferent) and Charlie (enjoys), and to a lesser extent Tessa and Heidi (both indifferent), reflected on and embraced their failure as a way to move forwards (see Box 4.1 for an example). These individuals tended to exhibit an active response to their failure, seeking self-improvement so that they could gain closure from the experience. However, confronting failure was often difficult. For example, perceptions of infallibility were discussed, with James needing to resolve his early belief that "every vet need[ed] to know everything about everything" and to "become much more humble".

In contrast, some individuals whose negative attitudes towards neurology did not improve seemed to reflect on their failure but struggled to see past the negative (see Box 4.2 for an example). Such stories suggested on-going self-recrimination and a lack of closure.

Repeated negative clinical experiences could cause frustration. Inability to obtain a diagnosis could result in dissatisfaction, with veterinarians feeling unable to grow their knowledge, apply their skills or obtain closure on a case. Dissatisfaction led towards negative perceptions of the experience. The effects of this dissatisfaction were exemplified by Jack's worsened attitude towards neurology (Box 4.3).

Although Mel and Emilia's (both dislikes) perspectives of neurology improved following a post-graduate course in neurology that lasted less than one year, their overall attitudes towards the discipline did not. Improvement in perspectives appeared to be associated with gaining a "real flow-charty-type" (Emilia) approach towards neurological cases that they were able to "refer back to" (Mel). Notably, the approach was drawn from connections they were given, and less from connections they made themselves. The lack of improvement in these participants' attitudes appeared to relate to a continued lack of connections and certainty. In contrast, all but one participant whose attitude towards neurology had improved had engaged in exposure to neurology specialists that lasted for at least a year. Notably, all participants whose attitude towards neurology had improved spoke of making connections themselves: "it loses its scariness once you can actually understand a little bit more, and 'oh, that's why that happens. Yeah, it makes sense'" (James, indifferent), "I didn't understand a whiff of it. … But now… [I] know what it means" (Wes, indifferent).

4.3.7.2 Improved perspectives towards neuroanatomy and neurophysiology

When participants expressed appreciation of the usefulness of neuroanatomy and neurophysiology, and interest in the how they explained clinical signs, these perspectives seemed to develop after graduation and were typically referenced during discussion of on-going learning. Participants provided several possible reasons why perceived relevance of neuroanatomy and neurophysiology developed after graduation.

Firstly, experience helped veterinarians make sense of the complexity of neurology and see the clinical relevance of neuroanatomy and neurophysiology. For example, Heidi (indifferent) described how revisiting neurophysiology through a lens obtained from clinical case management helped to change her perspectives but acknowledged the need for clinical relevance for this to occur: "when I read stuff on that. And I'm like, 'oh, that- that makes more sense now'. … but like that's the thing, it's that trying to teach that to a student [sic]".

Secondly, undergraduate workload and limited timeframes could hinder a drive to understand, as noted by Emilia ("There was just so much … that it was just like, 'oh my God! Briefly go over that, cover everything else'") and Michael ("I ended up always cramming. The intention was always there for deep learning, and it wasn't on purpose … Time always got the better of you. I mean, it's vet school. The amount of work is just insane"). There was the potential for greater opportunity to return to the subject and advance learning when workload and time pressures eased.

Thirdly, efforts to increase understanding of neurology and see connections typically developed out of an interest in neurology or a neurology-adjacent discipline (such as emergency and critical care, or surgery) or a desire to redress a perceived deficit in knowledge and ability. Such motivations were reported by James, Tessa, and Heidi (all indifferent), and Charlie, and Max (both enjoys). However, individuals were also less likely to re-explore detailed aspects of neurology if they were comfortable with not knowing or had insufficient interest. For example, Zoe (avoids), who was explicit in her lack of interest in neurology, described her on-going avoidance of neuroanatomy and neurophysiology when reviewing the subject for teaching or case management, "always looking at the clinical aspects of it rather than going back to the fundamental physiology and anatomy."

Box 4.1 James' reaction to failure: catalyst for self-improvement

James – case 1

> "I remember... my first, um, … steroid-responsive meningitis. Um, and not— not even knowing that existed until I looked it up, basically. You know, "why is the dog so painful? So young. Why does— why is he doing this? Why does he..." you know. And so, there was that, ah... not even a Eureka moment because I didn't even know that it existed anyway! (Laughs.) But there was— there was that moment of discovery, maybe after the fact, that— that this thing existed and then I could actually... I liked that one because I fixed it. I fixed him. His name was [gives name] and, um, the steroids fixed him, but... ah... it was one of the first cases I had that, um, made me a little more optimistic about neurology, um, and that there were some things that were fixable, manageable, or had a good outcome."

James – case 2

> "I remember doing every diagnostic that I could possibly do at my practice, um, and finding just nothing, nothing that... And, um, this was— ended up being a lymphoma case, and the dog just was clinically worse and worse and worse, became dysphagic and the owners wanted to do everything, but … there wasn't a neurologist anywhere that we could refer to. And I couldn't get a medicine referral for weeks. So, I was... I was it. Um, and so nothing— nothing worked on this dog. ... And I didn't know that could happen. I didn't know lymphoma could do that, so... had I... I remember thinking, you know, had I had cancer on my list, I would have euthanised this dog sooner … I had a neurologist tell me later, you can have a bunch of odd neuro signs and you can't quite put 'em together and then lymphoma should be, always be, close to the top of your list. It was... I was frustrated that... I... I thought I was doing a good neuro exam, and it wasn't getting me any closer to the answer. … Once I talked to someone about it and... and I got that advice... because you— hopefully, we all learn from our cases, um, then I was on the look— and then I was able to spot it the next time it happened. It's happened two or three times since then when I've had these weird... cranial nerve, or dysphagia... something's going on. Then it's like, let's go. Let's go find the weird lymph nodes. And that's been good because … there's not much that I can do for those dogs. They're... they're not as chemo-responsive as I would like. And I'm able to tell the clients to maybe make their decision a little faster."

Box 4.2 Sienna's reaction to failure: self-recrimination foremost

Sienna – case 1

> "Um, it was a... what... I now know was likely a vestibular disease in … an older dog, and I had no idea what it was … I didn't know how to approach it. I kind of panicked, gave the owner a very negative prognosis because the dog obviously had … something terrible. Um. And I didn't... euthanase it, but I just remember that sort of feeling of utter confusion about what was going on because the clinical signs seemed so severe, and so serious. And then... um, luckily, I didn't do anything other than admit it and sort of manage it symptomatically and then, um, in the morning got some help from one of my colleagues. And you're going to judge me horribly for not knowing something basic like that ... But I'd never— I'd never seen it before, but I don't ever remember even hearing about it at vet school ... I've seen ones subsequently, but I don't know how much of it was just my panic and making it, in my mind, bigger than it actually was."
>
> [Speaking of why this case had come to mind] "Just... the well, I guess... how... easily it would have been for me to go down... I didn't really know how to approach it logically … with neuro stuff … I just felt like I was flailing wildly, it's like "it's neurological! Argh!" (Laughs.) That sort of, um, I don't know, I don't have a logical series of steps to work through … and what that might m— what the results might mean in terms of where to go ne— you know, localising lesions, where to go next. Um, that sort of, that was my source of my panic, I think, as much as anything. And also, that I always felt neurological cases were "this is serious child, um (laughs), you need to kind of respond appropriately", or... yeah, I don't know. That kind of feeling."

Sienna – case 2

> "The only ones I remember are really ones where I didn't deal with— I didn't cover myself in glory at the time … But long story short, I was wrong … So, they were looking at euthanasia, and I was probably encouraging them towards that because I felt like it had a catastrophic spinal... injury. Um... but... it ended up being referred … and I remember just, that feeling of kind of, humiliation … You know, just feeling like, "oh, I'm such a..." because I was reasonably experienced by then, and I should have known better. … I just... feel like... that was a good outcome, but just freaked complete— you know, it could have easily been the other way and you would never— never have known any better if it hadn't been referred … And I don't really... there's so many of the basic stuff, things that I don't— I still feel like I'm not— I don't really understand how things work ... and also [not] having that structured approach to problems ... So, I feel confusion and... not terror anymore, but just like "urgh, it's neuro, it's going to be hard"."
>
> "Those are the two that stick in my mind the most, partly because I still feel a little bit shamefaced about both of them, I think. I think they— sort of, that sense of... you know, even though I learned a lot from them, I still feel like "oof", I was just not really confident then, I shouldn't have been allowed out."

Box 4.3 The effects of dissatisfaction on perspective of neurology: a case example.

As an undergraduate, Jack enjoyed learning neurology and enthused over the possibilities available in clinical diagnosis and treatment. However, on entering clinical practice Jack became disillusioned due to difficulties in evaluation, diagnosis, and treatment of clinical neurological cases:

> "I haven't had too much success because, ah, I ask someone to put it on deep bed straw and I get told to go somewhere." (Jack)

Repeated inability to diagnose or treat cases resulted in decreased perceived relevance of neurology and decreased enjoyment of the discipline. Jack's comments relating to his experiences of neurology after graduation tended to have an air of resignation that starkly contrasted with his animation when speaking of his undergraduate experiences.

> "It was really fascinating and learning about the grey matter, the white matter, the lower motor neuron, upper motor neuron - all of it was really, really cool … you send in a Saint Bernard for an x— ah, an MRI, it's— it's actually a really cool whole setup. And then you can actually get a segment-by-segment approach. And it's just something that... like I told you, if it was a cow I'd just walk down to the field and look at the down cow and go, "well, we're going to hip-hoist her". That's kind of— it's a very different world." (Jack)

> "I can't imagine that realistically there's a great approach to a lot of it. So, if they respond really well to steroids or Metacam... then we're golden... and she— she might come right eventually. If she doesn't, then... that's it." (Jack)

Jack maintained respect for the discipline and those who practiced it, and enjoyed opportunities when there was the possibility to revisit neurology theory. However, overall, Jack expressed little enjoyment of his clinical experiences of neurology after graduation.

4.4 Discussion

The present study constitutes the first qualitative exploration of veterinarians' attitudes towards neurology. This study explored veterinarians' perspectives of neurology, what influenced the development of those perspectives, how those perspectives influenced the person's behaviour towards neurological cases and learning, and how their experiences of neurology compared to experiences of other disciplines. My analysis revealed distinct but inter-linking themes that contributed to veterinarians' perspectives of neurology: Understanding and Retention, Motivation, Exposure, and Values and Traits. Contrary to previous literature on neurophobia, affective responses dominated these themes, even when intellectual factors were discussed. Affective responses also primarily drove changes in perspectives and attitudes towards neurology, with reaction to failure a key factor in motivation and self-belief. Factors that are specific to the veterinary profession, such as perceived animal value and discipline relevance, also emerged as drivers of motivation and affective responses towards neurology. The findings of this study suggest that differences in veterinarians' attitudes towards neurology are primarily dependent on their motivation, values and traits, and affective responses to their experiences rather than intellectual factors *per se*. Therefore, the possible underlying reasons for participants' differing affective responses towards neurology will now be explored further.

Although veterinarians with differing attitudes to neurology expressed differing perspectives there were also commonalities. Veterinarians with differing attitudes towards neurology described similar undergraduate and clinical experiences of neurology. Neurology was considered complicated and challenging with a high volume of detail to be learnt, and both theory and clinical cases were subject to high levels of uncertainty. However, veterinarians who were indifferent or enjoyed neurology typically developed understanding and connections between theory and clinical manifestations of neurological disease through logic and clinical reasoning. Veterinarians with negative attitudes towards neurology often disliked the uncertainty of neurology and neurological cases, preferring disciplines with clear approaches, clear answers and greater physical visualisation of concepts and pathology. Those with more positive attitudes towards neurology tended to better tolerate uncertainty, mitigating uncertainty through logic, reasoning and a focus on achievable process outcomes, such as the certainty gained through neurolocalisation.

The development of veterinarians' perspectives of neurology was underpinned by affective responses and how the individual reacted to those responses. Veterinarians described similar negative affective responses to their negative experiences of neurology, including confusion and frustration. But there were differences in the ways veterinarians reacted to difficulty and failure. These differences in reaction tended to determine whether difficulty and failure could lead to improvement in the individual's attitude (for example, by engaging with veterinary neurologists or seeking greater understanding) or strengthen a negative attitude (for example, through encouraging avoidance or negatively affecting self-belief).

Individuals' reactions to experiences, particularly perceived failure, were heavily dependent on personal values and motivation. Failure to uphold one's values can have emotional effects. For some individuals, failure may be galvanising, increasing motivation (Diener & Dweck, 1978). For others, failure can be emotionally devastating and trigger shame, actions of failure avoidance, and diminish self-worth (Covington & Omelich, 1985; Diener & Dweck, 1978; McGregor & Elliot, 2005). Factors such as impostor phenomenon can also modulate the level and type of emotional responses to failure (Bravata et al., 2020). Veterinarians who expressed comments suggestive of fear of failure, intolerance of uncertainty, and a tendency to reflect failure onto their perception of self were unlikely to engage in deeper understanding of neurology after encountering difficulty or failure with the discipline. Unwillingness to pursue further understanding of neurology appeared to result from internal dissonance created by mismatch between individuals' expectations of themselves and their perceived failure to achieve their goal(s). This internal dissonance could create a spectrum of affective responses, from mild (e.g. disinterest) to strong (e.g. guilt, shame, humiliation, decreased self-worth).

Failure could also be perceived as a representation of inherent inability or a temporary setback. Mindset reflects an individual's belief in their ability to overcome a challenging situation. Although mindset was not evaluated during interview questions, participants' comments suggested that variations in mindset could contribute to the factors identified in the Values and Traits element Self-belief and Drive to Improve. Previous research has noted that performance may not differ between individuals with fixed mindset and those with growth mindset, but there are marked differences in the way the individual reacts to failure (Diener & Dweck, 1980). Individuals with a fixed mindset attribute failure to inherent, and uncontrollable, lack of ability (Diener & Dweck, 1978). The effects of failure are cumulative and can lead to disengagement, with lower attribution of success to ability, underestimation of success (and overestimation of failure), and expectation of future failure, as well as lower psychological well-being and increased anxiety (Bostock et al., 2018; Diener & Dweck, 1978, 1980; Whittington et al., 2017). In contrast, individuals with a growth mindset display a mastery-oriented response to challenge. Individuals with a growth mindset attribute failure to lack of effort or experience, rather than lack of ability, and focus on how to remedy that failure.

Differences in participants' goal setting and affective responses to difficult situations also suggested differing levels and types of perfectionism. Perfectionism can be a positive motivator, provided goal-setting is realistic (Kruger et al., 2023; Lo & Abbott, 2013; Locicero & Ashby, 2000). This type of perfectionism, in which individuals strive to reach attainable goals, is termed ‘adaptive’. In contrast, maladaptive perfectionism is driven by fear of failure and attempts to reduce feelings of inferiority. Maladaptive perfectionism is associated with distress as individuals struggle to reach unrealistic goals (Lo & Abbott, 2013) and can lead to disengagement and avoidance as individuals seek to avoid negative consequences (Slade & Owens, 1998; Weiner & Carton, 2012). Amongst my participants, discussions of fear of failure, on-going self-recrimination and avoidance appeared consistent with maladaptive perfectionism. Additionally, success hinging on positive patient outcomes suggests unrealistic goal setting, given that negative clinical outcomes are relatively common in veterinary medicine. In comparison, veterinarians who were motivated by failure, focused more on process than outcome, and ascribed success to more than just positive patient outcome displayed characteristics consistent with adaptive perfectionism. These findings suggested that maladaptive perfectionism may be common amongst veterinarians that dislike/avoid neurology, while adaptive perfectionism may be more common amongst veterinarians with more positive attitudes towards neurology.

Many participants, regardless of their attitude towards neurology, considered neurology to be a discipline prone to uncertainty. Differing tolerance of uncertainty was notable between veterinarians who disliked/avoided neurology (low tolerance of uncertainty) and those with more positive attitudes towards neurology (greater tolerance or ease of managing uncertainty). Uncertainty risked failure, and therefore exacerbated anxiety associated with fear of failure, and could negatively affect validation when success hinged on obtaining a definitive answer. Uncertainty can also create ‘paralysis’, in which an individual feels unable to act (Berenbaum et al., 2008); expressions of difficulty moving forwards with neurological cases were common amongst veterinarians who disliked/avoided neurology. Both uncertainty and expectation of uncertainty have been associated with negative affective responses including frustration, panic and shame (Freeston et al., 2020), all emotions expressed by participants who disliked/avoided neurology. Intolerance of uncertainty could therefore contribute to negative perspectives of neurology, particularly amongst individuals who struggled to understand or retain neurological knowledge and were unwilling or unable to seek further understanding.

Values identified in the current thematic analysis included both personal and professional values, meaning that the theme Values and Traits reflected elements of personal and professional identity. Identity is a construct of an individuals’ values and morals, and the ways these dictate actions, decisions, and behaviours (Armitage-Chan & May, 2018). Identities are therefore reflections of “who I am” and influence “what I do”. Identities may be dynamic and contextual, meaning that any one person may have multiple identities, including personal and professional. Development of professional identity may be influenced by experiences and values both inside and outside of undergraduate and working environments (Nyström, 2009). In other words, personal values will contribute to professional identity. Consistent with this theory, previous studies have noted veterinarians' tendencies to closely integrate their sense of self with their professional identity (Armitage-Chan et al., 2016; Page-Jones & Abbey, 2015). A close connection between professional and personal identities means perceived failure in a professional context may be interpreted as failure as a person and as a veterinarian, not just failure in that one context. It is therefore unsurprising that some participants experienced such marked negative affective responses from difficulty and perceived failure that they sought to avoid future contexts in which their identity might be challenged.

As per the findings of Armitage-Chan and May (2018), my participants identified into two distinct variants of veterinary professional identity—diagnosis-focused and challenge-focused. Additionally, my participants also exhibited different affective responses when faced with contextual difficulty. Individuals who prioritised obtaining definitive answers (or, 'diagnosis-focused') tended to dislike the uncertainty inherent in neurology. In contrast, individuals who were driven by self-improvement, found enjoyment in the process of case management, and could obtain satisfaction through helping and learning, seemed more tolerant of uncertainty and often had more positive attitudes towards neurology. It is possible that a focus on process provided protection of self-worth, as failure was not a reflection of failure as a person but failure of the process, which in turn can be changed.

Perception of an experience as positive or negative could also hinge on context, with similar outcomes potentially resulting in vastly different affective responses, even in the same individual. For example, owner reactions could create emotional closure despite euthanasia, or emotional deflation despite clinical success. Affective responses could therefore be triggered and tempered by varying factors, with the type and strength of the response depending on the individual's values and motivation.

Some of the themes identified in the current study, such as Understanding and Retention and Exposure, were reminiscent of findings of studies exploring neurophobia in the medical profession (Ansakorpi et al., 2017; Fantaneanu et al., 2014; Kam et al., 2013; McCarron et al., 2014; Youssef, 2009). The findings within Understanding and Retention were also consistent with previous educational literature unrelated to neurophobia, for example, Marton and Pang (2006), Entwistle (1988). Consistent with the previous literature (see Table 2.4), Understanding and Retention was a prevalent theme in the current study. However, while intellectual factors were discussed, veterinarians' perceived level of knowledge was less important than how it affected their ability to uphold their values and remain motivated. It was the affective responses to difficulty or ease of understanding and retaining knowledge that dictated veterinarians' perspectives of neurology. This is an important distinction. Most studies into neurophobia in medical students and the medical profession focus on intellectual rather than affective difficulty when determining whether an individual is neurophobic. Additionally, proposed interventions to address neurophobia in the medical profession primarily focus on addressing intellectual difficulty. My data suggests that unless affective responses are also considered and addressed, educational interventions may be unsuccessful. Additionally, species-related differences in animal value and willingness for owners to pursue clinical care creates questions of practical relevance that are not found in previous neurophobia literature. While reducing intellectual difficulty could reduce negative affective responses, inherent difficulties such as difficulty obtaining a definitive diagnosis in neurological cases, perceived lack of relevance in a clinical setting, a low frequency of case exposure, and an inherent limited understanding of the nervous system, could continue to feed negative perspectives of neurology depending on veterinarians' values and motivation .

My data explored elements of veterinarians' perspectives of non-neurological disciplines as well as their perspectives of neurology. Participants' reasons for enjoyment or dislike of other disciplines typically mirrored their reasons for enjoyment or dislike of neurology, suggesting similar underlying factors. The identified similarities both support the justifications for my interpretations and suggest that the influences of relatively stable factors, such as personal values and personality traits, deserve further evaluation both in regard to neurophobia and other subjects that are considered difficult.

My anecdotal experience and knowledge of previously published literature risked bias—the analysis reflects my interpretation of the data and other interpretations are possible. However, the credibility of my findings is strengthened through the process by which data were analysed. Coding was from audio recordings and verbatim transcriptions that had been verified by participants, the analysis was systematic, and all transcripts were coded before codes were searched for patterns to create consolidating themes. Although some interviews were performed online, this was unlikely to have affected my findings as interpretation of data collected through online video interviews has been reported to be comparable to that obtained through in-person interviews (Jenner & Myers, 2019; Krouwel et al., 2019) and coding was based on transcribed comments with meaning clarified by inflection and context. Despite my awareness of the results of previous investigations of neurophobia I was careful to avoid superficial analysis. This care may have contributed to the emergence of themes that did not completely align with previous medical literature. Previous literature on neurophobia has primarily focused on intellectual challenges encountered when learning neurology or managing neurological cases. However, my data identified affective responses associated with these experiences that wove throughout, underpinned, and linked the themes. It is possible that my own experiences learning neurology and managing neurological cases may have introduced bias to my interpretations, as I could relate to many stories participants shared. However, those same experiences afforded me insight to help group similar affective responses while also highlighting viewpoints that differed from my own.

My lack of previous experience with qualitative research also risked bias and likely influenced my findings. Although inexperience might be viewed negatively, it can also be beneficial. My awareness of my lack of experience increased the depth and frequency of my scrutiny of my findings, encouraged me to repeatedly refer to literature and my supervisors to check my method, and resulted in multiple iterations of code groups before finding the best fit into the elements and themes described in this chapter. Additionally, my lack of experience with qualitative research may have been tempered by my previous experiences learning and teaching neurology, which have required me to recognise different perspectives and engage in reflection; qualities that are needed during exploration of qualitative data.

Interviews are created through a social interaction between the interviewer and interviewee. They are dynamic and unlikely to be exactly reproducible. As indicated by Manderson et al. (2006, p. 1320), which "stories are told… vary according to the social relationship of the storyteller and his or her audience, and on social and cultural conventions of public and private, shared and withheld". The rapport between the interviewer and interviewee can therefore influence the stories told and how they are conveyed. Discrepancies and similarities in demographics may affect the ease of questioning, openness of discourse, willingness to speak on sensitive subjects and understanding of what is discussed (Manderson et al., 2006). In the current study, both the participants and I had experienced veterinary education. Furthermore, I have both general practice, academic and referral level experience providing a measure of shared understanding despite the variety in career paths of participants. The relatively small number of veterinary professionals globally also fosters a degree of informality between members of the profession which was expected to help alleviate any tension. While many of the participants were known to me – given the collegial nature of the veterinary profession – at the time of the interviews, I was not employed by a veterinary clinic. As such, interactions with participants were primarily casual rather than professional, and phrasing of the interview questions was designed to reduce any concerns the individual might have regarding judgement of their performance.

The cohort of interviewed veterinarians is very small when compared to the size of the veterinary profession. Nevertheless, phenomenographic studies have suggested a sample size of 20 individuals is typically appropriate to obtain 'all the different ways of understanding the phenomenon' (Larsson & Holmström, 2007). In this study, only 18 veterinarians were interviewed. However, participants shared similar experiences and described similar responses. There were few situations in which only one participant offered a particular view, suggesting that most experiences and opinions shared by participants were common. Additionally, interview participants' undergraduate training took place in a variety of countries, but their undergraduate experiences were similar. Although theoretically a phenomenon may inspire an infinite number of perceptions, our understanding and creation of meaning is shaped by social influences, typically resulting in only 2-6 variations in our understanding of that phenomenon (Larsson & Holmström, 2007; Marton, 1986).

Most of the participants were employed at Massey University or had undertaken further post-graduate education. This could suggest a bias towards participants with a greater willingness to learn or desire to be challenged, and low diversity of voices within the interviewed population. However, there was at least one specialist in each of the attitude categories (disliked/avoided neurology, indifferent and enjoyed neurology), indicating that the level of academic exposure alone did not dictate attitude towards neurology. Additionally, there were at least two participants with only general practice clinical experience in each attitude category. Although unplanned, this resulted in a range of both positive and negative experiences and perspectives expressed by participants in each category. The depth at which data analysis occurred also likely helped to mitigate effects of any lack of diversity. Participants expressed a range of affective responses, personality traits and values. It was these responses, traits and values that primarily differed between participants with differing attitudes towards neurology, not their academic or employment background.

The inclusion of participants with an academic background may also have aided data collection and allowed greater exploration of underlying affective responses. Participants from academic backgrounds may be more used to participating in research and therefore more willing to openly and honestly discuss their experiences, may have greater experience articulating concepts due to their day-to-day clinical teaching of students, and may be more used to reflecting on their actions. Such factors would be expected to aid researchers' understanding of each individual's thought processes and reduce misinterpretation. Further investigation would be required to understand whether veterinarians of other backgrounds express alternative or additional contributors to their attitudes towards neurology.

Participants were asked to discuss their experiences of neurology and neurological cases, many of which took place several years prior. As such, it was possible that participants' memory of that experience and the associated affective responses was distorted or had changed through the lens of subsequent experiences. However, any alteration of those memories would also affect the participants' current perspective of neurology, meaning that over- or underestimation of the affective responses related to that experience were still relevant. Additionally, participants tended to recount situations that triggered greater affective responses and often spontaneously offered explanations not only of how that experience affected them at the time but also how their view had changed on retrospection. Therefore, although nuances were likely lost due to the time lapse between the event and the interview, the intervening time also allowed participants to verbally reflect on their interpretations of the event and focus on greater affective triggers.

Although distinct themes emerged from the data, there was no clear process by which a veterinarians' attitude towards neurology developed. One's identity and personality factors, such as what drove and motivated individuals (fear of failure vs. striving to attain a goal), tolerance of uncertainty, and mindset and self-belief, directed how they reacted to difficult experiences learning and applying neurology. This finding is not unexpected, given that it aligns with the postpositivist view of causality that a perspective is shaped by multiple interacting factors rather than a direct linear path (Maxwell & Mittapalli, 2010). However, it means that the findings of the analysis may not be specific to neurology but rather common to any difficult subject veterinarians, or any other learners, encounter.

4.5 Conclusion

The findings of thematic analysis of this cohort of veterinarians suggested attitudes towards neurology could be shaped by understanding and retention of theoretical neurology knowledge, an individual's experiences and familiarity with neurological cases, their motivation, and their values and traits. Furthermore, the data suggested professional identity, what drove and motivated individuals (maladaptive vs. adaptive perfectionism), tolerance of uncertainty, and mindset and self-belief, may be pivotal in developing veterinarians' attitudes towards neurology, particularly when difficulty or failure have been experienced. The influences of motivation and values and traits on perspectives of neurology are not well-recognised in neurophobia literature. Therefore, these affective factors warrant further evaluation to determine their influence on veterinarians' perspectives of neurology and why they develop. The following chapters will present the results of questionnaires that further explore these themes and affective factors in populations of veterinarians (Veterinary Views: A Quantitative 5) and undergraduate veterinary students (Chapter 6) and how a veterinarians' affective responses might explain differences in perspectives of neurology (Chapter 7).

5 Veterinary Views: A Quantitative Evaluation of Veterinarian's Perspectives of Neurology

5.1 Introduction

In the qualitative arm of this thesis veterinarians were interviewed about their experiences of neurology, both as a student and clinician. Many interviewed veterinarians made comments that suggested personality traits may have influenced their perspectives of neurology (see Chapter 4). Facets of self-judgement, self-belief, and tolerance of uncertainty were frequently noted on analysis of interview transcripts. It was unknown whether the perspectives of the interviewees, or the potential factors underlying them, were shared by the wider veterinary profession. In this second phase of my research veterinarians were surveyed to investigate their perspectives of neurology and experiences learning and practicing neurology.

In this chapter, I sought to elucidate veterinarians' experiences of neurology and how these experiences compare to other veterinary disciplines. This quantitative study also explored social and contextual factors and whether these informed veterinarians' perspectives, and whether there are common mitigating factors that influence veterinarians' preferences. In Chapter 7, these differences in perspectives, traits, and emotions will be used to develop a model proposing possible contributors to negative and positive attitudes toward neurology.

5.2 Research Method

An online survey of registered veterinarians was conducted. The survey questions were informed by the findings of the analysis undertaken in the qualitative arm of this thesis (Chapter 4) and review of medical literature on "neurophobia" (Figure 2.2). The questionnaire was administered using Qualtrics[5] and was open for 14 weeks.

5.2.1 Recruitment

An invitation to complete an anonymous online questionnaire exploring veterinarians' perspectives of neurology was advertised in several veterinary publications, newsletters of governing bodies, and

[5] Qualtrics. (2020) (Version October, 2022). Provo, Utah, USA: Qualtrics. Retrieved from https://www.qualtrics.com

social media posts. Respondents who completed the questionnaire could choose to enter a prize draw. Veterinarians were eligible for inclusion if they were registered with the veterinary governing bodies of Australia, New Zealand, or the United Kingdom.

5.2.2 Questionnaire

A complete version of the questionnaire is provided in Appendix A: Systematic Review, Interview and Survey Information. The questionnaire was divided into six sections: baseline information, how neurology compared to other disciplines, perspectives of neurology, aspects of veterinary practice that are important to the respondent, measures of perfectionism, and measures of tolerance of uncertainty. Respondents may not have been asked all questions—follow-up questions depended on answers provided. The questionnaire combined open- and closed-ended questions, including Likert scales, ranking questions, and selecting items from lists. In accordance with the university's ethics procedures, the veterinary survey underwent internal review, including peer consultation and completion of a risk assessment form. Based on this process, the project was classified as low ethical risk, and full ethics approval was not required (Ethics Notification Number 4000025698).

The first section collected baseline information about the participants gender, year of graduation, country in which they undertook their undergraduate veterinary degree, and the respondent's professional veterinary experience. Respondents were also questioned about their training in neurology after graduation.

How neurology compared to other disciplines

In the second section, respondents were asked which non-neurology disciplines they most enjoyed and most disliked, and why. Respondents were then asked to indicate how well the reasons they enjoyed or disliked those disciplines applied to neurology. Comparisons of reasons a discipline was enjoyed or disliked were subsequently collapsed into the categories "*Applies less or does not apply to neurology*" and "*Applies more to neurology or to the same degree*".

Perspectives of neurology

In the third section, respondents were questioned about their perspectives of neurology, including aspects of neurology they enjoyed, found easy, and found difficult, and expectations of difficulty when dealing with neurological cases. Respondents were also asked how frequently they saw neurological cases. Respondents ranked aspects of neurological case management for emotionally difficulty, from

0 (*'Not at all emotionally difficult'*) to 10 (*'Extremely emotionally difficult'*). Perspectives of neurology before and after graduation, and the reasons for change in perspectives, were also sought. Respondents also answered questions intended to evaluate mindset based on the approach of Armitage-Chan and Maddison (2019). Due to questionnaire length and applicability of findings, only a subset of the questions used by these authors were included (see Appendix A: Systematic Review, Interview and Survey Information for further information and Table A.2 for the adapted questions). Higher scores in the mindset scale indicate more of a growth mindset, while lower scores indicate more of a fixed mindset.

Aspects of veterinary practice that are important to the respondent

In the fourth section, respondents were asked a series of questions to identify elements of clinical practice they considered important. To understand how respondents defined their professional identity, they were asked to select three statements that best defined the role and requirements of a veterinarian. These statements were based on the findings of previous investigations into veterinary professional identity (for example, Armitage-Chan, Maddison and May, (2016). To understand what was important to each veterinarian, respondents were asked what was most likely to make them feel they had been "successful" with a case and to rank the importance of 10 different case management priorities from most (1) to least (10) important. Rankings 1-3 were collapsed to form the category *most important priorities* and rankings 8-10 were collapsed to form the category *least important priorities*.

Measures of perfectionism

In the fifth section, respondents were asked to complete the 24-item adaptation of the Frost Multidimensional Perfectionism Scale (FMPS-24) (Khawaja & Armstrong, 2005) (see Appendix A: Systematic Review, Interview and Survey Information). The FMPS-24 has been shown to have high internal consistency, to highly correlate with the original 35-item Frost Multidimensional Perfectionism Scale, and to support the four dimensions identified in previous studies: Concerns over Mistakes and Doubts about Actions, Parental Expectations and Parental Criticism, Personal Standards, and Organisation (Khawaja & Armstrong, 2005). The survey phases of the current research included a large number of questions. Therefore, the FMPS-24 was chosen over the FMPS to because of its shorter length and concerns over the time required to fill in the questionnaire. Results of the FMPS-24 are reported as scores for each subscale of the four dimensions, and as Total Perfectionism scores. Total Perfectionism scores are calculated as the sum of all the subscale scores except Organisation. The Organisation subscale score is not included in the Total Perfectionism score as organisation is not considered to be intrinsically problematic. However, a high Organisation subscale score can exacerbate other aspects of perfectionism.

The higher the score in each FMPS-24 subscale and in the Total Perfectionism score, the greater the level of perfectionism. The FMPS-24 subscales Concerns over Mistakes and Doubts about Actions, Parental Expectations and Parental Criticism have been linked to maladaptive perfectionism. The subscales Personal Standards, and Organisation have been linked to adaptive perfectionism.

Measures of tolerance of uncertainty

Finally, respondents were asked to complete the Intolerance of Uncertainty scale (Buhr & Dugas, 2002) adapted to focus responses on uncertainty relating to neurology (see Appendix A: Systematic Review, Interview and Survey Information for further information and the adapted questions). Intolerance of uncertainty has been defined as "an excessive tendency to find uncertain situations stressful and upsetting, to believe that unexpected events are negative and should be avoided, and to think that being uncertain about the future is unfair" (Dugas et al., 2005, p. 58). Serial variation in intolerance of uncertainty has been reported (Carnahan et al., 2022; Shapiro et al., 2020). Because intolerance of uncertainty appears to be malleable, and the focus of my research was specific to neurology, I elected to adapt a pre-existing instrument to focus the respondent on their reactions towards uncertainty in neurology. This adaptation was also intended to counter any variation in tolerance of uncertainty due to risk aversion and perceptions of risk associated with neurology. For example, some interview participants spoke of comfort in non-neurological disciplines due to having an approach to follow. The approach was perceived to decrease the risk of making mistakes. In contrast, disciplines in which an approach was lacking were perceived as higher risk of mistakes. There are several instruments available for evaluating intolerance of uncertainty. I chose to use the Intolerance of Uncertainty Scale (IUS) because it has been reported to have excellent internal consistency and good test-retest reliability (Buhr & Dugas, 2002; Freeston et al., 1994). Additionally, the scale has been shown to correlate with other measures of worry, depression and anxiety (Buhr & Dugas, 2002). These correlations also contributed to the choice to employ the IUS in my research as comments made by interview participants often seemed to associate uncertainty with discomfort in clinical decision-making and fear of making mistakes.

The IUS consists of 27 questions assessing individuals' affective responses to uncertainty, with respondents selecting one of the following answers: Not at all characteristic of me; A little characteristic of me; Somewhat characteristic of me; Very characteristic of me; or Entirely characteristic of me. The IUS version created by Buhr and Dugas (2002) has four dimensions, representing "the idea that uncertainty is stressful and upsetting, uncertainty leads to the inability to act, uncertain events are negative and should be avoided, and being uncertain is unfair" (Buhr & Dugas, 2002, p. 942). My choice to adapt this version of the IUS was also influenced by how these dimensions resonated with the findings of my interviews. To minimise effects on validity, changes to question wording were limited as much as possible. The wording changes are outlined in Appendix A, Table A.3.

The higher the score in the Intolerance of Uncertainty scale, the less tolerant the individual is of uncertainty. Additionally, because tolerance of uncertainty is malleable, respondents were asked to use a sliding scale to record their level of agreement with three uncertainty statements: I am comfortable dealing with uncertainty when I am working, I am comfortable dealing with uncertainty in my personal life, and I struggle with uncertainty more when the stakes are higher.

5.2.3 Data analysis

Respondents were unable to proceed with the questionnaire if they did not indicate their attitude toward neurology. Responses to the question "What is your overall view of neurology?" were collapsed into three categories: *Disliked/avoided neurology, Indifferent to neurology* and *Enjoyed neurology*. Respondents who were indifferent to neurology were subsequently excluded from the analysis. The decision to exclude those indifferent to neurology allowed data analysis to focus on investigation and identification of the differences between participants with the extremes in the spectrum of attitude towards neurology, to help establish initial themes or hypotheses. Exclusion of the indifferent respondents did risk loss of nuance that may be obtained from consideration of the moderate or transitional perspective. However, this study aimed to identify factors that differed between veterinarians with clearly negative attitudes towards neurology and veterinarians with clearly positive attitudes towards neurology, and loss of nuance was considered a valid trade-off for greater clarity in understanding of extreme attitudes at this early stage in the research. Descriptive statistics were primarily employed to evaluate the data. Categorical responses were collapsed for analysis when responses aligned with others to form an overarching theme.

Comparison of categorical responses from questionnaire respondents with negative (*Disliked/avoided neurology*) or positive (*Enjoyed neurology*) attitudes towards neurology was undertaken using either Pearson's Chi-squared test or Fisher's exact test. Prevalence ratio and 95% confidence intervals were then calculated for response categories in which significant differences were detected. Differences between the two response categories in their scores of the Multidimensional Perfectionism Scale (FMPS-24), the adapted Intolerance of Uncertainty scale, the adapted mindset scale, and responses provided by sliding scales were evaluated via the Kruskal-Wallis ANOVA test. For all statistical tests, differences were considered significant at $p < 0.05$.

Statistical comparisons were undertaken using R statistical software (R Core Team, 2022).

5.3 Results

A total of 128 veterinarians commenced the questionnaire, 18 were excluded as they did not answer the question about their attitude towards neurology and were unable to continue the questionnaire. A further 28 were indifferent to neurology and not included in further analysis. The final data set for analysis comprised 82 respondents: 49 (60%) who disliked or avoided neurology and 33 (40%) who enjoyed neurology. Most respondents were female, graduated in or later than 2000, and had companion animal experience (Table 5.1). Respondents who had not worked in referral practice were 2.3 times more likely to dislike/avoid neurology than respondents who had worked in referral practice (30/34 vs. 18/29; $p = 0.02$, 95% CI [0.98, 5.56]).

Respondents who disliked/avoided neurology were most likely to have no formal training in neurology after graduation, could easily refer a neurology case and saw less than one neurology case a month (Table 5.2). Among respondents who had completed an internship or residency (any discipline) of at least one-year duration with frequent interaction with neurologists, significantly fewer respondents disliked/avoided neurology than enjoyed neurology ($p < 0.001$). There were no significant differences in attitude when the longest neurology course after graduation was less than one year.

Table 5.1 Baseline information for survey respondents stratified by their attitude to neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a]

	Number (%)[b]		
Variable	Disliked/avoided	Enjoyed	*P*
Gender (*n* = 82)			0.38
Female	41 (84%)	24 (73%)	
Male	7 (14%)	8 (24%)	
Another gender or not provided	1 (2%)	1 (3%)	
Year of graduation (*n* = 80[a])			1
Prior to 2000	15 (31%)	10 (31%)	
2000 or later	33 (69%)	22 (69%)	
Veterinary sector experience (*n* = 63[a])			
General practice	26 (76%)	16 (55%)	0.11
Referral practice	4 (12%)	11 (38%)	0.05
Academia or research	4 (12%)	5 (17%)	0.73
Government or industry	3 (9%)	1 (3%)	0.62
Species treated (*n* = 67[a, c])			
Companion animal	40 (95%)	24 (96%)	1
Equine	4 (10%)	3 (12%)	0.70
Production animal	6 (14%)	2 (8%)	1
Other	8 (19%)	5 (20%)	1
Country of undergraduate studies (*n* = 80[a])			0.13
Australia	14 (29%)	12 (38%)	
New Zealand	11 (23%)	12 (38%)	
United Kingdom	15 (31%)	7 (22%)	
Other[d]	8 (17%)	1 (3%)	
Countries in which respondents have practiced (*n* = 80[a])			
Australasia			
Yes	27 (56%)	25 (78%)	0.08
No	21 (44%)	7 (22%)	
United Kingdom			
Yes	31 (65%)	16 (50%)	0.29
No	17 (35%)	16 (50%)	

[a]Of those that disliked/avoided neurology, data were missing for year of graduation (*n* = 1), veterinary sector (*n* = 15), species treated (*n* = 7), country of undergraduate study (*n* = 1), and country in which they had practiced (*n* = 1). Of those that enjoyed neurology, data were missing for year of graduation (*n* = 1), veterinary sector (*n* = 4), species treated (*n* = 8), country of undergraduate study (*n* = 1), and country in which they had practiced (*n* = 1).

[b]Percentages reflect the proportion of respondents in each attitude category.

[c]Multiple variables could be selected for the question.

[d]Undergraduate studies in Europe (*n* = 5) and Africa (*n* = 4).

Table 5.2 Veterinarians' training in neurology and exposure to neurological cases after graduation and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Number (%)[b] Disliked/ avoided	Enjoyed	*P*	Prevalence ratio [95% CI]
Completed formal neurology course or ≥1-year internship/residency with frequent interaction with neurologists after graduation (*n* = 80)			**<0.0001**	
Completed a neurology course or ≥1 year internship/ residency with frequent interaction with neurologists	5 (10%)	19 (59%)		REF
No formal course and did not work with neurologist	43 (90%)	13 (41%)		3.69 [1.67, 8.15]
Longest neurology course or interaction with neurologists after graduation (*n* = 24[c])				
Neurology course lasting <1 year	2 (40%)	4 (21%)	0.34	0.54 [0.17, 1.69]
≥1-year internship/residency (any discipline) with frequent interaction with neurologists	3 (60%)	15 (79%)	**<0.001**	0.23 [0.08, 0.65]
Typical number of neurology cases seen per month (*n* = 73)			**0.01**	
One or more	24 (53%)	23 (82%)		REF
Less than one	21 (47%)	5 (18%)		1.58 [1.13, 2.22]
Ease of referral of neurological cases (*n* = 74)			**0.03**	
No neurologist to refer to	3 (7%)	8 (27%)		REF
Not very easy	17 (39%)	6 (20%)	**0.03**	0.37 [0.14, 1.00]
Easy or very easy	24 (55%)	16 (53%)	0.05	0.45 [0.17, 1.23]

[a]Of those that disliked/avoided neurology, data were missing for completion of formal neurology course or worked with a neurologist after graduation (*n* = 1), ease of referral of neurological cases (*n* = 5), and typical number of neurology cases seen per month (*n* = 4). Of those that enjoyed neurology, data were missing for completion of formal neurology course or worked with a neurologist after graduation (*n* = 1), ease of referral of neurological cases (*n* = 3), and typical number of neurology cases seen per month (*n* = 5).

[b]Percentages reflect the proportion of respondents in each attitude category.

[c]Multiple variables could be selected for the question. Figures provided indicate the longest option chosen by the participant even if they selected multiple variables.

REF = reference statement for prevalence ratio calculation.

5.3.1 How neurology compared to other disciplines

When asked to select their most enjoyed clinical discipline from a list that did not include neurology, respondents most commonly chose internal medicine (26 of 82 respondents; 32%), soft tissue surgery (17 of 82 respondents; 21%), or emergency and critical care (11 of 82 respondents; 13%). Respondents who disliked/avoided neurology were most likely to enjoy their preferred discipline because they were comfortable recognising and/or interpreting the clinical presentation, they often felt they had helped the client or patient, and they knew how to approach the cases (Table 5.3).

Most respondents indicated their least enjoyed disciplines were orthopaedics (14 of 82 respondents; 17%), dentistry (nine of 82 respondents; 11%), or nutrition (nine of 82 respondents; 11%). Respondents who disliked/avoided neurology were most likely to dislike their least enjoyed discipline because they did not feel in control when dealing with cases, they often felt they had not done a good job, and they got stressed (Table 5.4).

Participants were subsequently asked how well the reasons they enjoyed (Table 5.5) or disliked (Table 5.6) a discipline applied to neurology. The variables "applies less" and "does not apply" were collapsed to form "applies less/does not apply". The variables "applies to the same degree" and "applies more" were collapsed to form "applies the same/more". Respondents who felt the following reasons they enjoyed a discipline applied less or did not apply to neurology were significantly more likely to dislike/avoid neurology: "I know how to approach these cases" (p <0.001), "I am comfortable recognising and/or interpreting clinical presentations" (p = 0.01). Respondents who felt the following reasons they did not enjoy a discipline applied equally or more to neurology were significantly more likely to dislike/avoid neurology: "I often feel I have not done a good job" (p = 0.02), "I don't feel in control when dealing with these cases" (p = 0.02), and "I get stressed" (p = 0.03). All respondents who enjoyed their preferred discipline or disliked their least enjoyed discipline because cases are challenging, reported that neurological cases are equally or more challenging.

Table 5.3 Reasons respondents enjoyed their preferred discipline and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 46)	Enjoyed *n* (% of 32)	*P*	Prevalence ratio [95% CI]
I am comfortable recognising and/or interpreting the clinical presentation	21 (46%)	11 (34%)	0.45	1.21 [0.84, 1.74]
I often feel I have helped the client and/or patient	18 (39%)	9 (28%)	0.45	1.21 [0.84, 1.75]
I know how to approach these cases	17 (37%)	10 (31%)	0.78	1.11 [0.76, 1.61]
Cases are fascinating	10 (22%)	15 (47%)	**0.04**	0.59 [0.35, 0.99]
I can make a positive difference	8 (17%)	14 (44%)	**0.02**	0.54 [0.30, 0.96]
I feel in control when dealing with these cases	11 (24%)	6 (19%)	0.79	1.13 [0.75, 1.70]
Cases are challenging	8 (17%)	8 (25%)	0.59	0.82 [0.48, 1.38]
I frequently see these conditions	8 (17%)	6 (19%)	1	0.96 [0.59, 1.58]
I can "see"/find answers in diagnostic investigations	10 (22%)	1 (3%)	**0.02**	1.69 [1.27, 2.26]
I often feel I have done a good job	7 (15%)	3 (9%)	0.51	1.22 [0.77, 1.92]

[a]Data were missing from 3 respondents who disliked/avoided neurology and 1 respondent who enjoyed neurology.

Respondents could select up to 3 variables to answer the question. *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

Table 5.4 Reasons respondents disliked their least enjoyed discipline and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 46)	Enjoyed *n* (% of 31)	*P*	Prevalence ratio [95% CI]
I often feel unable to do as much as I should	7 (15%)	11 (35%)	**0.04**	0.59 [0.32, 1.08]
Cases are boring	8 (17%)	11 (35%)	0.12	0.64 [0.37, 1.12]
It has little relevance to my workday	6 (13%)	8 (26%)	0.26	0.68 [0.36, 1.27]
I am usually hampered by costs	10 (22%)	3 (10%)	0.28	1.37 [0.95, 1.98]
I don't feel in control when dealing with these cases	13 (28%)	5 (16%)	0.34	1.29 [0.90, 1.86]
I don't know how to approach these cases	8 (17%)	3 (10%)	0.51	1.26 [0.83, 1.92]
I am not comfortable recognising and/or interpreting the clinical presentations	9 (20%)	4 (13%)	0.65	1.20 (0.79, 1.82)
I get stressed	11 (24%)	6 (19%)	0.85	1.11 [0.74, 1.67]
I often feel I have not done a good job	11 (24%)	8 (26%)	1	0.96 [0.62, 1.48]

[a] Data were missing from 3 respondents who disliked/avoided neurology and 2 respondents who enjoyed neurology.

Respondents could select up to 3 variables to answer the question. *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

Table 5.5 The prevalence ratio that the reason a respondent enjoyed a preferred discipline applied less to neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (%)		Enjoyed *n* (%)			Prevalence ratio [95% CI] statement applied less or did not apply
	Applies less/ does not apply	Applies the same/more	Applies less/ does not apply	Applies the same/more	*P*	
I know how to approach these cases	16 (94%)	1 (6%)	2 (22%)	7 (78%)	**<0.001**	7.11 [1.13, 44.80]
I am comfortable recognising and/or interpreting clinical presentations	17 (85%)	3 (15%)	4 (36%)	7 (64%)	**0.01**	2.70 [1.02, 7.11]
Cases are fascinating	2 (20%)	8 (80%)	0 (0%)	15 (100%)	0.15	2.88 [1.64, 5.03]
I often feel I have done a good job	6 (86%)	1 (14%)	1 (33%)	2 (67%)	0.18	2.57 [0.50, 13.11]
I can "see"/find answers in diagnostic investigations	8 (89%)	1 (11%)	0 (0%)	1 (100%)	0.2	2.00 [0.50, 8.00]
I can make a positive difference	5 (63%)	3 (38%)	7 (50%)	7 (50%)	0.67	1.39 [0.44, 4.43]
I often feel I have helped the client and/or patient	12 (67%)	6 (33%)	5 (63%)	3 (38%)	1	1.06 [0.61, 1.84]
I feel in control when dealing with these cases	10 (91%)	1 (9%)	5 (100%)	0 (0%)	1	0.67 [0.47, 0.95]
Cases are challenging	0 (0%)	7 (100%)	0 (0%)	8 (100%)	1	—
I frequently see these conditions	7 (88%)	1 (13%)	6 (100%)	0 (0%)	1	0.54 [0.33, 0.89]

[a]Data were missing from 4 respondents who disliked/avoided neurology and 2 respondents who enjoyed neurology - one respondent who disliked/avoided neurology and one respondent who enjoyed neurology did not indicate how the reasons they enjoyed their preferred discipline applied to neurology.

Percentages represent the proportion of respondents in each attitude category who chose the response. *P*-values were calculated comparing the number of respondents that selected the "applies less/does not apply" variable to the number that selected the "applies the same/more" variable.

Statements initially selected by fewer than 10 respondents were excluded from the table due to low numbers.

Due to rounding percentages may not equal 100.

Table 5.6 The prevalence ratio that the reason a respondent disliked a least enjoyed discipline applied to the same degree or more to neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (%)		Enjoyed *n* (%)			Prevalence ratio [95% CI] statement applied less or did not apply
	Applies less/ does not apply	Applies the same/more	Applies less/ does not apply	Applies the same/more	*P*	
I often feel I have not done a good job	3 (27%)	8 (73%)	7 (88%)	1 (13%)	**0.02**	2.96 [1.12, 7.85]
I don't feel in control when dealing with these cases	2 (15%)	11 (85%)	4 (80%)	1 (20%)	**0.02**	2.75 [0.88, 8.64]
I get stressed	4 (36%)	7 (64%)	5 (100%)	0 (0%)	**0.03**	2.25 [1.08, 4.67]
I often feel unable to do as much as I should	1 (14%)	6 (86%)	7 (70%)	3 (30%)	0.05	5.33 [0.81, 35.33]
I don't know how to approach these cases	2 (25%)	6 (75%)	3 (100%)	0 (0%)	0.06	0.40 [0.14, 1.17]
I am not comfortable recognising and/or interpreting the clinical presentations	3 (33%)	6 (67%)	3 (75%)	1 (25%)	0.27	0.58 [0.25, 1.37]
Cases are boring	6 (86%)	1 (14%)	11 (100%)	0 (0%)	0.82	0.35 [0.19, 0.67]
I am usually hampered by costs	2 (22%)	7 (78%)	1 (33%)	2 (67%)	1	0.86 [0.36, 2.05]
It has little relevance to my workday	6 (100%)	0 (0%)	8 (100%)	0 (0%)	1	NC

[a]Data were missing from 4 respondents who disliked/avoided neurology and 3 respondents who enjoyed neurology - one respondent who disliked/avoided neurology and one respondent who enjoyed neurology did not indicate how the reasons they disliked their least preferred discipline applied to neurology.

Percentages represent the proportion of respondents in each attitude category who chose the response. *P*-values were calculated comparing the number of respondents that selected the "applies the same/more" variable to the number that selected the "applies less/does not apply" variable.

NC = Not able to calculate because of zero values.

Statements initially selected by fewer than 10 respondents were excluded from the table due to low numbers.

Due to rounding percentages may not equal 100.

5.3.2 Perspectives of neurology

Respondents who disliked/avoided neurology were most likely to not find anything easy with neurological cases, most enjoy learning from neurological cases, and find lack of knowledge the most difficult aspect of neurology (Table 5.7). No respondents who disliked/avoided neurology most enjoyed the diagnostic approach, challenge, or ease of management of neurological cases. Only respondents who disliked/avoided neurology felt their greatest difficulty was not understanding the "basics" of neurology (six of 45 respondents who disliked/avoided neurology; 13%). No respondent who enjoyed neurology considered insufficient experience their greatest difficulty with neurology.

Respondents were subsequently asked to select any other aspects of neurology they enjoyed, found easy, and found difficult. When respondents selected all applicable variables, respondents who disliked/avoided neurology were most likely to enjoy learning from neurological cases, find it easy to manage their expectations of themselves, and worry about mistakes (Table 5.8). No respondents who enjoyed neurology reported that neurology made them feel they were not a good veterinarian, or they did not have a good approach to neurological cases. Some respondents commented further on aspects of neurology that they enjoyed, found easy or found difficult. Examples of these comments are provided in Appendix B, Table B.2 and Table B.3.

Respondents who disliked/avoided neurology were most likely to have maintained a negative perspective of neurology since their undergraduate studies, despite likely neutral experiences of neurology following graduation (Table 5.9). Respondents who disliked/avoided neurology were most likely to feel the greatest influence on their perspectives of neurology was their experiences of neurology after graduation. At various points during the questionnaire, some respondents commented on aspects of their undergraduate experiences of neurology or experiences of neurology after graduation that related to their attitude towards neurology. Examples of these comments are provided in Appendix B,Table B.4.

The median mindset score for respondents who disliked/avoided neurology was significantly lower than the median mindset score for those who enjoyed neurology (p = 0.04) (Figure 5.1).

Table 5.7 The most common aspects of neurology that respondents most enjoyed, found easiest and found most difficult, and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 45)	Enjoyed *n* (% of 28)	*P*	Prevalence ratio [95% CI]
The aspect of neurology respondents enjoyed the most (*n* = 73)			**<0.01**	
Neurological cases are interesting	7 (16%)	5 (18%)		REF
I can learn from the case	10 (22%)	1 (4%)		0.64 [0.38, 1.07)]
I can problem-solve to find answers	6 (13%)	5 (18%)		1.07 [0.52, 2.20]
The most difficult aspect of neurology (*n* = 73)			**<0.01**	
Barriers to obtaining a diagnosis	6 (13%)	14 (50%)		REF
Not knowing enough	10 (22%)	3 (11%)		0.39 [0.19, 0.81]
The aspect of neurology respondents found easiest (*n* = 73)			0.07	
Performing the neurological examination	9 (20%)	12 (43%)		REF
I don't find anything easy	11 (24%)	2 (7%)		0.30 [0.15, 0.59]

[a]Data were missing from 4 respondents who disliked/avoided neurology and 5 respondents who enjoyed neurology.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

REF = reference statement for prevalence ratio calculation.

Table 5.8 The most common aspects of neurology that respondents enjoyed, found easy and found difficult, and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 45)	Enjoyed *n* (% of 28)	*P*	Prevalence ratio [95% CI]
Aspects of neurology respondents enjoyed (*n* = 73)				
I enjoy the diagnostic approach	7 (16%)	15 (54%)	**0.001**	0.44 [0.22, 0.86]
The challenge of cases	6 (13%)	13 (46%)	**<0.01**	0.43 [0.23, 0.80]
Neurology is logical	14 (31%)	18 (64%)	**0.01**	0.58 [0.38, 0.89]
I can learn from the case	33 (73%)	13 (46%)	**0.04**	1.61 [1.02, 2.55]
I can problem-solve to find answers	17 (38%)	18 (64%)	0.05	0.66 [0.45, 0.97]
I can make sense of my examination findings	4 (9%)	8 (29%)	0.05	0.50 [0.22, 1.13]
I feel good about myself when cases go well	23 (51%)	9 (32%)	0.12	1.34 [0.94, 1.92]
Neurological cases are interesting	21 (47%)	19 (68%)	0.13	0.72 [0.50, 1.04]
I like being viewed as intelligent/respected by others when I manage neurological cases	5 (11%)	5 (18%)	0.49	0.79 [0.41, 1.50]
I can make a difference to patients' quality of life	17 (38%)	11 (39%)	1	0.98 [0.67, 1.42]
I can make a difference to owners' quality of life	11 (24%)	6 (21%)	1	1.07 [0.71, 1.60]
Aspects of neurology respondents found easy (*n* = 73)				
Performing the neurological examination	11 (24%)	19 (68%)	**<0.001**	0.46 [0.28, 0.76]
Managing most clients' expectations	9 (20%)	13 (46%)	**0.03**	0.58 [0.34, 0.99]
Interpreting the neurological examination	2 (4%)	7 (25%)	**0.03**	0.33 [0.10, 1.14]
I don't find anything easy	11 (24%)	2 (7%)	0.11	1.49 [1.08, 2.06]
Devising a treatment plan	6 (13%)	5 (18%)	0.74	0.87 [0.49, 1.54]
Explaining the problem(s) to most owners	11 (24%)	8 (29%)	0.91	0.92 [0.60, 1.42]
Managing my expectations of myself	13 (29%)	7 (25%)	0.93	1.08 [0.73, 1.59]
Maintaining good relationships with most clients	6 (13%)	9 (32%)	0.1	0.59 [0.31, 1.13]
All difficult aspects of neurology (*n* = 73)				
Insufficient experience	21 (47%)	1 (4%)	**<0.001**	2.03 [1.50, 2.75]
Feeling I have not done a good job	13 (29%)	0 (0%)	**0.001**	1.90 [1.49, 2.43]
Lacking an approach	10 (22%)	0 (0%)	**0.01**	1.80 [1.44, 2.24]
Worrying about mistakes	27 (60%)	8 (29%)	**0.02**	1.63 [1.11, 2.38]
Not knowing enough	23 (51%)	6 (21%)	**0.02**	1.59 [1.12, 2.25]
Feeling like I am not a good vet	8 (18%)	0 (0%)	**0.02**	1.73 [1.40, 2.13]
Barriers to obtaining a diagnosis	19 (42%)	19 (68%)	**0.03**	0.67 [0.46, 0.98]
Insufficient time to think before acting	12 (27%)	2 (7%)	**0.04**	1.53 [1.12, 2.09]
Feeling there is little that can be done	8 (18%)	3 (11%)	0.51	1.22 [0.80, 1.85]
Uncertainty of neurology	15 (33%)	7 (25%)	0.62	1.16 [0.80, 1.67]
Big effect on animal's/owner's life	15 (33%)	11 (39%)	0.79	0.90 [0.61, 1.34]
Unable to "see" the cause	8 (18%)	6 (21%)	0.94	0.91 [0.56, 1.49]
Feeling the weight of owners' expectations	14 (31%)	8 (29%)	1	1.05 [0.71, 1.54]
Insufficient support	8 (18%)	5 (18%)	1	1.00 [0.62, 1.60]

[a]Data were missing from 4 respondents who disliked/avoided neurology and 5 respondents who enjoyed neurology.
Multiple variables could be selected for each question. *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.
Statements selected by fewer than 10 respondents were excluded from the table due to low numbers unless *P*<0.05 for the variable.

Table 5.9 Respondents' positivity towards their experiences of neurology as an undergraduate and after graduation, factors that most influenced respondents' perspectives of neurology and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Number (%)[b] Disliked/avoided *n* (%)	Number (%)[b] Enjoyed *n* (%)	*P*	Prevalence ratio [95% CI]
Undergraduate experiences of neurology (*n* = 69)			**<0.01**	
Negative	22 (52%)	9 (33%)		REF
Neutral	16 (38%)	6 (22%)		0.98 [0.69, 1.37]
Positive	4 (10%)	12 (44%)		2.84 [1.18, 6.83]
Experiences of neurology following graduation (*n* = 68)			**<0.001**	
Negative	8 (19%)	0 (0%)		REF
Neutral	29 (69%)	4 (15%)		1.14 [1.00, 1.29]
Positive	5 (12%)	22 (85%)		5.40 [2.45, 11.91]
How perspective of neurology experiences changed (*n* = 65)			0.67	
Improved	17 (44%)	14 (54%)		REF
Unchanged	18 (46%)	9 (35%)		0.82 [0.54, 1.25]
Worsened	4 (10%)	3 (12%)		0.96 [0.47, 1.97]
Factor that had the greatest influence on perspectives of neurology (*n* = 70)			**0.01**	
Experiences of veterinary neurology after graduation	19 (44%)	14 (45%)		REF
Undergraduate experiences of neurology-based subjects	13 (30%)	3 (10%)		0.71 [0.49, 1.03]
Support from colleagues/specialists	11 (26%)	5 (10%)		0.84 [0.54, 1.30]
Other	0 (0%)	5 (16%)		NaN [NaN, NaN]

[a]Of those that disliked/avoided neurology, data were missing for undergraduate experiences of neurology (*n* = 7), experiences of neurology following graduation (*n* = 7), how perspective of neurology experiences changed (*n* = 10), and factor that had the greatest influence on perspectives of neurology (*n* = 6). Of those that enjoyed neurology, data were missing for undergraduate experiences of neurology (*n* = 6), experiences of neurology following graduation (*n* = 7), how perspective of neurology experiences changed (*n* = 7), and factor that had the greatest influence on perspectives of neurology (*n* = 6).

[b]Percentages reflect the proportion of respondents in each attitude category.

Due to rounding percentages may not equal 100.

REF = reference statement for prevalence ratio calculation.

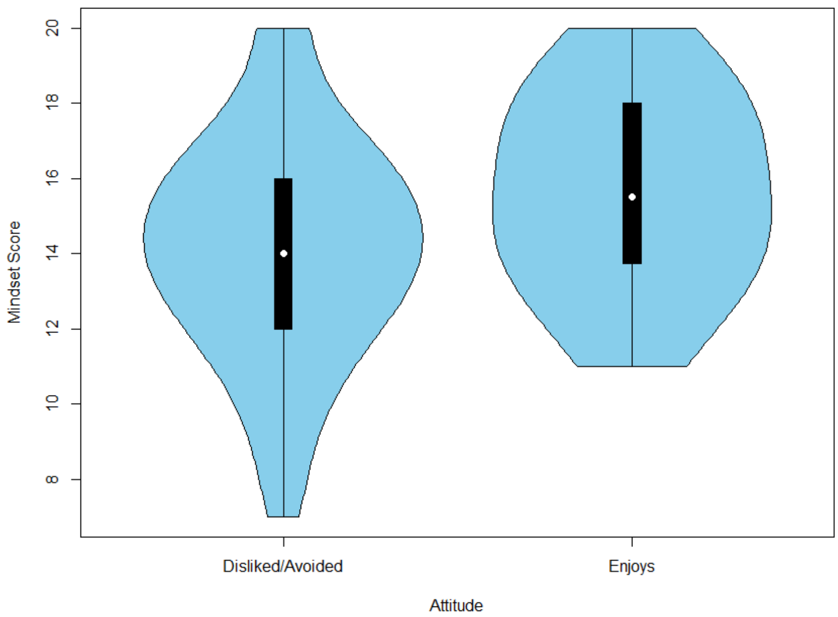

Figure 5.1 Distribution of mindset scale scores amongst respondents with different attitudes towards neurology. Data from 73 survey respondents: 45 who disliked/avoided neurology and 28 who enjoyed neurology. The violin plots depict respondents' scores for the mindset scale; the median score was significantly lower for respondents who disliked/avoided neurology compared to those who enjoyed neurology (p = 0.04).The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for the scale are 0-20. Higher scores indicate a tendency towards a growth mindset.

5.3.3 Aspects of veterinary practice that are important to the respondent

Both respondents who disliked/avoided neurology and those who enjoyed neurology were most likely to believe communicating knowledge to owners so they can make choices and providing skilled animal care best defined the roles or requirements of a veterinarian (Table 5.10).

Respondents' most and least important clinical priorities are provided in Appendix B, Table B.5. Respondents who considered meeting the needs of the owner one of their three most important priorities were 2.6 times less likely to dislike/avoid neurology (p = 0.002, 95% CI [1.41, 4.68]). There were no other significant differences.

Several of the factors that were most likely to make respondents feel "successful" related to positive problem outcomes—finding an answer for the problem, "fixing" the problem, and the patient being able to go home (see Appendix B, Table B.6). Other factors related to case interactions—helping the patient even if it is life-ending, having the owner feel satisfied, feeling they had personally made a difference, and learning from the case. Respondents who disliked/avoided neurology were most likely to select factors linked to positive problem outcomes (14 of 45 (31%) versus five of 27 (19%) respondents who enjoyed neurology; *p* = 0.06). There were no significant differences between respondents who disliked/avoid neurology and respondents who enjoyed neurology for the factors that were most likely to make respondents feel "successful" (see Appendix B, Table B.6).

Several of the factors that caused respondents the greatest difficulty when dealing with veterinary cases of any discipline were associated with meeting one's own standards—time pressures preventing respondents from completing all tasks to a standard with which they are happy, feeling not good or knowledgeable enough, dealing with uncertainty when an answer is not found to explain the problem, and meeting one's expectations of oneself (see Appendix B, Table B.6). Respondents who disliked/avoided neurology were most likely to select factors associated with meeting one's own standards (20 of 45 (44%) versus six of 27 (22%) respondents who enjoyed neurology; *p* = 0.06). There were no significant differences between respondents who disliked/avoid neurology and respondents who enjoyed neurology for factors that caused respondents the greatest difficulty when dealing with veterinary cases of any discipline (see Appendix B, Table B.6).

Respondents' levels of emotional difficulty when dealing with aspects of neurological case management are depicted in Appendix B, Figure B.1. Median scores between respondents who disliked/avoided neurology and those who enjoyed neurology significantly differed for level of emotional difficulty regarding limitations in their ability to make a plan (e.g. time pressure, knowing where to start) (*p* <0.001), their understanding of neurological cases (*p* <0.001), and their ability to make a positive difference (*p* = 0.04). Respondents who disliked/avoided neurology found each of these situations more emotionally difficult.

Regardless of their attitude towards neurology, most respondents (51 of 73; 70%) believed most veterinarians don't like neurology. Respondents who disliked/avoided neurology tended towards more negative expectations of neurological cases and negative perspectives of outcome and overall feelings towards neurological cases, while respondents who enjoyed neurology were more positive (Appendix B, Table B.7). Respondents who expected neurological cases would be difficult before even seeing the case were 2.2 times more likely to dislike/avoid neurology (95% CI [1.31, 3.54]).

Table 5.10 The most common statements respondents believed best defined the roles or requirements of a veterinarian (features of professional identity). Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 45)	Enjoyed *n* (% of 27)	*P*
Communicating knowledge to owners so they can make choices	23 (51%)	16 (59%)	0.67
Providing skilled animal care	23 (51%)	15 (56%)	0.90
Continuous learning and professional development to improve animal care	18 (40%)	12 (44%)	0.90
Prioritising animal welfare/life, even when at odds with client/owner wishes	14 (31%)	3 (11%)	0.10
Educating clients about ways to improve animal care	11 (24%)	5 (19%)	0.78
Guiding owners to make the right choice for their animal	9 (20%)	5 (19%)	1
Problem-solving to provide answers to owners	7 (16%)	6 (22%)	0.54
Being able to admit our own limitations in knowledge and/or ability	8 (18%)	4 (15%)	1
Doing everything possible to obtain the optimum patient outcome	5 (11%)	5 (19%)	0.49

[a]Data were missing from 4 respondents who disliked/avoided neurology and 6 respondents who enjoyed neurology.

Respondents could select up to 3 variables to answer the question. *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

5.3.4 Measures of perfectionism

All questions of the FMPS-24 scale were completed by 44 of the 49 respondents who disliked/avoided neurology and 26 of the 33 respondents who enjoyed neurology. Mean and median total perfectionism scores were similar between attitudes towards neurology (Figure 5.2). However, the range of scores amongst respondents who disliked/avoided neurology was almost double that of respondents who enjoyed neurology.

All questions of the Concerns over Mistakes and Doubts about Actions FMPS-24 and Organisation FMPS-24 subscales were completed by 45 respondents who disliked/avoided neurology and 27 respondents who enjoyed neurology. All questions of the Personal Standards FMPS-24 subscale and Parental Expectations and Parental Criticism FMPS-24 subscales were completed by 44 respondents who disliked/avoided neurology and 27 respondents who enjoyed neurology. The total scores for each subscale are depicted in Figure 5.3. The median Personal Standards subscale score was significantly lower for respondents who disliked/avoided neurology than those who enjoyed neurology ($p = 0.03$).

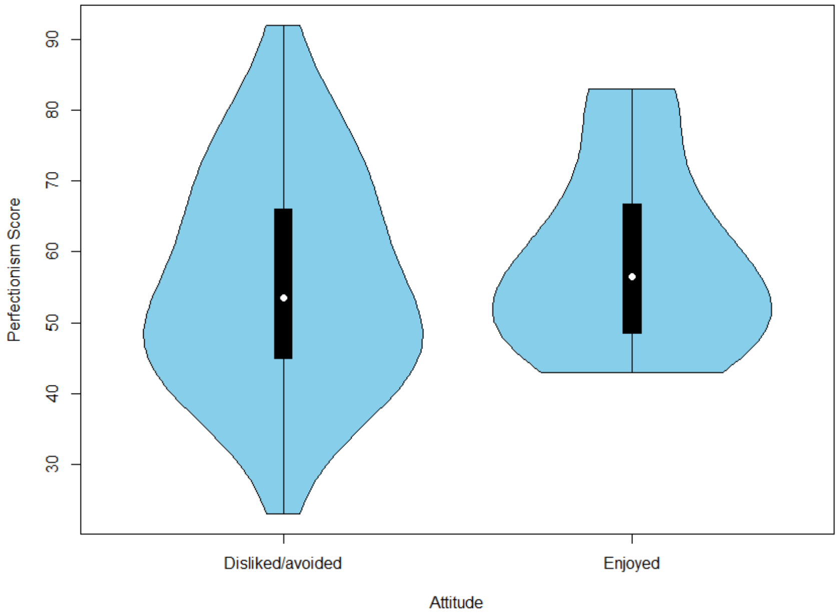

Figure 5.2 Distribution of perfectionism scale scores amongst respondents with different attitudes towards neurology. Data from 44 respondents who disliked/avoided neurology and 26 respondents who enjoyed neurology. The violin plots depict respondents' total scores for the Perfectionism Scale; the median score was higher amongst respondents who disliked/avoided neurology ($p = 0.27$, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores range from 20-100. Higher scores indicate higher levels of perfectionism.

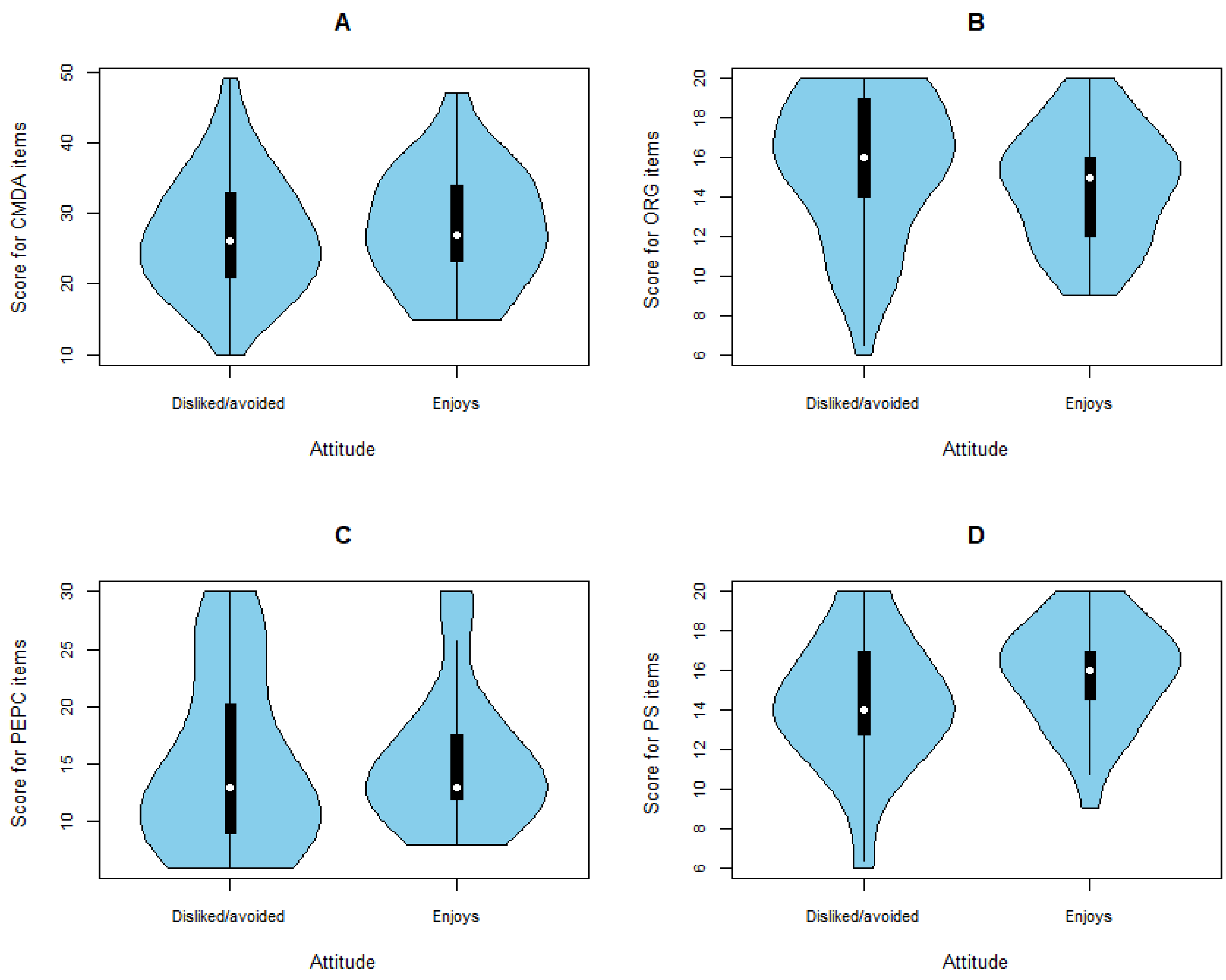

Figure 5.3 Distribution of perfectionism subscale scores amongst respondents with different attitudes towards neurology. The violin plots depict respondents' overall scores for the Perfectionism scale subscales A) Concern over Mistakes and Doubts about Actions (CMDA) (p = 0.51, df = 1), B) Organisation (ORG) (p = 0.29, df = 1), C) Parental Expectations and Parental Criticism (PEPC) (p = 0.48, df = 1), and D) Personal Standards (PS) (**p = 0.03**, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for each scale are 10-50 for the CMDA scale, 6-30 for the PEPC scale, and 4-20 for ORG and PS scales. Higher scores indicate higher levels of perfectionism.

5.3.5 Measures of tolerance of uncertainty

The adapted Intolerance of Uncertainty scale was completed by 45 of the 49 respondents who disliked/avoided neurology and 27 of the 33 respondents who enjoyed neurology. The median score was significantly higher for respondents who disliked/avoided neurology than those who enjoyed neurology (p = <0.001) (Figure 5.4).

For the statement "I am comfortable dealing with uncertainty when I am working" median agreement was significantly lower for respondents who disliked/avoided neurology than those who enjoyed neurology (p <0.001). There were no significant differences in median level of agreement for the statements relating to uncertainty in respondents' personal lives or in high stakes situations (see Appendix B, Figure B.2).

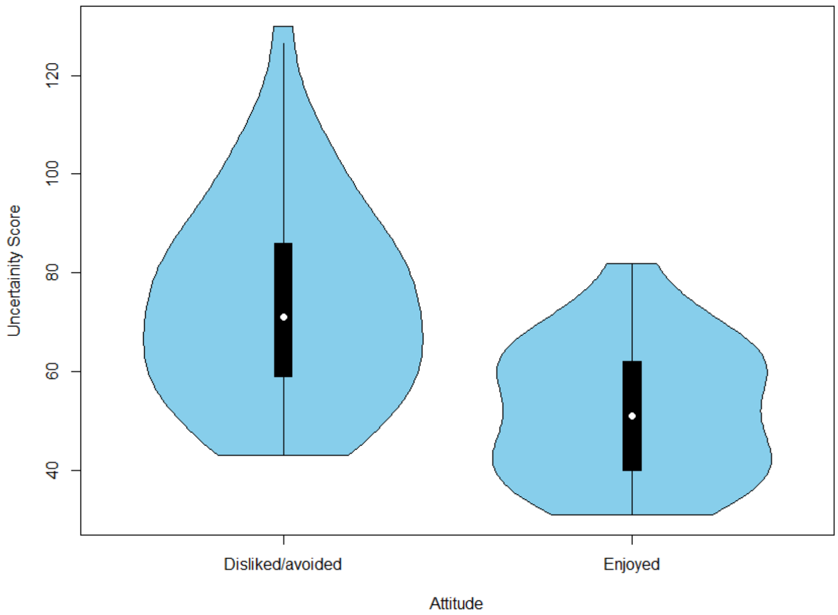

Figure 5.4 Distribution of Intolerance of Uncertainty scale scores amongst respondents with different attitudes towards neurology. Data from 45 respondents who disliked/avoided neurology and 27 respondents who enjoyed neurology. The violin plots depict respondents' score for the Intolerance of Uncertainty scale; the median score was higher amongst respondents who disliked/avoided neurology (p <0.001, df = 1).. The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for each scale are 27-135. Higher scores indicate higher intolerance of uncertainty.

5.4 Discussion

This is the first quantitative study evaluating, in depth, veterinarians' perspectives of neurology. The primary aim of this research was to understand factors that predispose to the extremes of attitude towards neurology. Of the total 110 respondents, almost half of the respondents surveyed disliked/avoided neurology, while almost one-third enjoyed neurology. Most of this cohort of veterinarians, regardless of their personal attitude towards neurology, believed that most veterinarians don't like neurology. Many respondents indicated difficulty with neurology arose from intellectual or external factors, such as not knowing enough and barriers to obtaining a diagnosis. However, differences in affective responses were frequently present between respondents with differing attitudes towards neurology, with respondents who disliked/avoided neurology more likely to report, for example, worry over making mistakes and enjoyment when there was certainty, while respondents who enjoyed neurology tended to embrace challenge. Therefore, many findings of this survey appeared attributable to, or at least influenced by, affective responses and personality traits.

Affective responses and traits are expected to contribute to differences in individuals' perceptions of any given event (Brosch et al., 2013; Sliter et al., 2015; Zadra & Clore, 2011). Hence, questions in this survey assessed respondents' affective reactions to their experiences of neurology and other disciplines, their perception of veterinary professional identity, and traits such as perfectionism and mindset to better understand what underlies veterinarians' perspectives of neurology and how they develop. The choice to evaluate deeper reasons why veterinarians adopted a particular view of neurology was intended to highlight factors that may not be obvious to the respondents themselves or would be impossible to glean from superficial questioning. However, traits are not context specific. Choosing to explore deeper emotions and traits reduced my findings' specificity for neurology. It is likely that my findings would equally apply to other veterinary disciplines that respondents find difficult, challenging, or uncertain. The current study into veterinary perspectives of neurology therefore acts as a case study to advance understanding of how emotional responses, identity and traits may influence veterinarians' perspectives of a veterinary discipline.

Answers from respondents who disliked/avoided neurology seemed contradictory at times. Respondents who enjoyed learning from neurological cases were significantly more likely to dislike/avoid neurology than enjoy neurology. However, respondents who enjoyed the learning process of investigating and reasoning through the case, or the challenge it posed were significantly less likely to dislike/avoid neurology. Additionally, half the respondents who enjoyed their preferred discipline because cases were challenging disliked/avoided neurology, despite finding neurological cases similarly or more challenging than the discipline they enjoyed. The survey method of data collection prevented further exploration of reasons for this apparent conditional enjoyment of learning and challenge. Other survey findings did, however, suggest several possible explanations.

Firstly, respondents who disliked/avoided neurology tended to place greater importance on outcome—getting a definitive diagnosis, finding solutions, and being able to cure or "fix" the problem—than respondents who enjoyed neurology. Additionally, respondents who disliked/avoided neurology expressed greater emotional difficulty when dealing with limitations in their ability to make a plan, their understanding of neurological cases, and their ability to make a positive difference to neurological cases. Respondents who considered these outcomes important, and experienced emotional difficulty when unable to achieve these outcomes, might only enjoy learning or challenge if it culminates in an answer, a solution, a positive outcome, or the feeling that they have helped the patient.

Alternatively, a more fixed mindset might explain a respondent's conditional enjoyment of learning and challenge—learning and challenge might only be enjoyed when the individual believes they can be successful, or they are comfortable or familiar with the nature of the learning or challenge. Conditional enjoyment of challenge might also reflect a tendency towards different types of goal setting. Elliott and Dweck (1988) reported individuals who set goals focused on learning and increasing one's competence tended towards challenge-seeking and mastery-oriented response to failure, even if self-perceived ability was low. These individuals would be expected to enjoy challenge, no matter the outcome. In contrast, when individuals focus on other people's perception of their performance, they may adopt challenge avoidance and learned helplessness, particularly if ability is self-perceived as low. Several respondents who disliked/avoided neurology made comments suggesting they focus on others' perception of their performance, with references to fear of repercussions should they fail (Appendix B, Table B.3). Finally, it is possible that respondents who disliked/avoided neurology experienced greater emotional difficulty and increased self-doubt during problem-solving when the solution was less certain. Interviews or factor analysis might provide greater understanding of what circumstances influence a veterinarian's enjoyment of learning and challenge.

Respondents who expect neurological cases to be difficult were significantly more likely to dislike/avoid neurology. However, fewer respondents who disliked/avoided neurology felt the case was as bad as expected after seeing it (Appendix B, Table B.7), suggesting that expectations of neurological cases tended to be more negative than the reality. Exaggerated expectation of difficulty suggests an affective component contributed to respondents' answers. Understanding if, and how, emotion contributed to exaggerated negative expectations of neurological cases would, again, require further investigation. However, intolerance of uncertainty likely contributes to negative expectations, with uncertainty increasing stress and anxiety about how the case might present. The concept of uncertainty distress, "the subjective negative emotions experienced in response to the as yet unknown aspects of a given situation" (Freeston et al., 2020, p. 2), warrants future consideration. According to this concept, distress develops due to the uncertainty itself, and the state of not knowing, rather than the presence or perception of a threat. Uncertainty distress has been linked to a range of negative emotions, from frustration to panic and shame, and can relate to events that have happened, are happening, or might happen (Freeston et al., 2020). Although it has not yet been evaluated, stress and anxiety associated with uncertainty might heighten the negative effects of lower self-belief amongst individuals with less of a growth mindset or lower confidence secondary to infrequent exposure to neurological cases.

Negative experiences of neurology as an undergraduate were more common than negative experiences of neurology after graduation. Undergraduate experiences did not necessarily have a long-lasting influence—one-third of respondents who reported they currently enjoyed neurology indicated their undergraduate perspectives were negative, while almost 10% of respondents who currently disliked/avoided neurology considered their undergraduate experiences positive. Respondents in all attitude categories predominantly ascribed changes in their perspectives to their experiences of neurology after graduation. Understanding how, why, and what experiences effected a change in perspective is important if we are to understand whether and how we might, as educators, support veterinarians in developing a more positive perspective towards neurology. Findings of the survey suggested several possible contributors to whether experiences after graduation were perceived as positive or negative, including the potential for alignment or mismatch between one's experiences and professional priorities, how the individual reacted to mismatch between their experiences and professional priorities, and whether experiences of neurology included aspects of veterinary practice the individual enjoyed.

Mismatch between experiences with neurological cases and an individual's professional priorities might cause dissatisfaction. In contrast, alignment between experiences with neurological cases and an individual's professional priorities might increase satisfaction. There were no significant differences in how survey respondents defined their professional identity or what was most likely to make them feel "successful", suggesting there was little difference in professional priorities between respondents with differing attitudes towards neurology. However, a greater proportion of respondents who disliked/avoided neurology tended to associate "success" with factors linked to positive problem outcomes—finding an answer for the problem, "fixing" the problem, and the patient being able to go home—compared to respondents who enjoyed neurology. Commonly reported difficulties with neurological cases included barriers to obtaining a diagnosis, insufficient knowledge, neurological disorders causing a big effect on an animal's or owner's life, and uncertainty, all potential hindrances to a positive problem outcome. It is therefore possible that individuals focused on problem outcome may struggle to find satisfaction with neurological cases. In contrast, compared to respondents who disliked/avoided neurology, a greater proportion of respondents who enjoyed neurology defined the role or requirements of a veterinarian as progression of the veterinary profession through experiential and/or scientific learning. Individuals focused on intellectual advancement, personally or for the veterinary profession, might find greater alignment between neurological cases and their professional priorities, leading to greater satisfaction.

Personality traits might temper or exaggerate the effects of mismatch between one's experiences of neurological cases and professional priorities. Individuals with greater tolerance of uncertainty, realistic goal setting, and less tendency to see failure as a reflection of self-worth, may be more accepting of mismatch. In contrast, individuals who set less achievable goals, have less of a growth mindset, and less resilience to failure, may have difficulty resolving the negative effects of mismatch. Veterinarians with a diagnosis-focused identity have previously been associated with poor emotional health (Armitage-Chan & May, 2018). In the current study, comments from some respondents who disliked/avoided neurology also suggested negative emotional consequences of perceived failure, even when the cause was beyond the individual's control. Feeling "emotionally drained", "not good enough", a "burden" to others, and lacking trust in oneself resulted from failing to achieve a positive clinical outcome (Appendix B, Table B.3). In these situations, mismatch between neurological experiences and professional priorities appeared to have long-lasting emotional consequences.

Respondents who enjoyed neurology did not report any negative experiences after graduation. It is unclear if this means that these respondents did not experience any negative experiences of neurology or if they did not perceive any experiences as negative. Possible reasons for not perceiving an experience as negative include the potential to find enjoyment in more than just a good case outcome. For example, neurological cases provided the intellectual stimulation favoured by most respondents who enjoyed neurology. Respondents who enjoyed neurology enjoyed the challenge of neurological cases, the logic of neurology, the diagnostic process, the ability to problem-solve, and making sense of findings. These aspects of neurological evaluation are incorporated into the processes of clinical interpretation, clinical reasoning, and diagnostic investigations. As integral components of clinical evaluation, they would be employed in almost every case and would provide enjoyment regardless of patient outcome.

As discussed in Chapter 4, there are two forms of perfectionism: adaptive perfectionism and maladaptive perfectionism. The perfectionism subscales *Personal Standards* and *Organisation* are associated with adaptive perfectionism. Adaptive perfectionism, the positive form of perfectionism, has been associated with high personal standards and striving for perfectionism, with realistic goals and high self-efficacy helping to reduce stress (Kruger et al., 2023; Lo & Abbott, 2013; Locicero & Ashby, 2000). In the context of my research, realistic goal setting associated with adaptive perfectionism might lead to an alternative source of positivity when respondents who enjoyed neurology dealt with neurological cases. Most respondents who enjoyed neurology reported they felt "successful" when they had helped a patient, even if that help led to the patient's death. "Helping" is not only an attainable goal but is more realistic than expecting to cure a neurological problem. Additionally, adaptive perfectionism and more of a growth mindset may mean that failure is viewed less negatively, provided the individual can view failure as a learning experience.

For respondents that disliked/avoided neurology, neither positive undergraduate experiences nor positive experiences after graduation resulted in a positive attitude towards neurology. Most respondents who disliked/avoided neurology had neutral experiences of neurology after graduation. Presumably, experiences of neurology after graduation were insufficiently positive to change a negative undergraduate perspective of neurology. There are several possible explanations for this. Firstly, the concept of positivity is relative. Experiences labelled as positive may have been better than expected, but not markedly positive. Secondly, while case outcome may have been positive or the respondent was able to learn from the case, the reward may be less if this outcome or learning is obtained indirectly through referral or the actions of others. Multiple respondents commented on the dissatisfaction of referral compared to working up cases themselves (Appendix B, Table B.3 and Table B.4). Indirect attainment of positive outcome or learning may limit feelings of goal achievement or alignment with identity. Decreased affective reward through referral might also have contributed to worsening perspectives of neurology amongst respondents who had viewed their undergraduate experiences positively. Thirdly, it is possible that some respondents viewed referral of neurological cases as a positive experience due to the associated reduction in stress. However, referral can also enable avoidance and would not be expected to improve one's attitude towards neurology.

Differing levels of exposure to neurological cases resulted in multiple significant differences between respondents who disliked/avoided neurology and those who enjoyed neurology. Respondents who considered a lack of experience not only a difficult element of neurology but also the most difficult element of neurology were significantly more likely to dislike/avoid neurology. Additionally, respondents with no formal exposure to neurology after graduation and who infrequently saw neurological cases (<1 case per month) were significantly more likely to dislike/avoid neurology. In contrast, respondents who had formal exposure to neurology or neurology specialists following graduation, and who saw >1 neurological case per month were significantly more likely to enjoy neurology. The length of formal exposure to neurology or neurology specialists following graduation was also significant. My data suggests short courses in neurology are unlikely to significantly improve a negative attitude towards neurology—an important consideration for educators.

It is unclear whether infrequent exposure to neurological cases was a contributing cause or effect of dislike/avoidance of neurology. Infrequent exposure could negatively affect confidence and limit knowledge retention, potentially contributing to discomfort with a discipline. Alternatively, dislike could lead to avoidance and decreased exposure to neurological cases. It is also unclear whether greater exposure to neurological cases was the cause or effect of enjoyment of neurology. Individuals who enjoy neurology might seek out employment opportunities with greater exposure to neurological cases or a closer working relationship with neurologists. Another possibility is that familiarity could ease discomfort and provide more opportunity to learn from cases.

The type of exposure to neurological cases seemed as pivotal as the amount of exposure—the level of opportunity to manage and diagnose neurological cases appeared important in the development of respondents’ perspectives of neurology. Respondents who had no neurologist to refer to were significantly more likely to enjoy neurology. Individuals unable to refer cases would need to perform diagnostic investigations and treatments themselves, thereby gaining experience, knowledge and potentially confidence. Importantly, respondents’ comments suggested satisfaction was also gained from investigation and management of neurological cases, while early and frequent referral created dissatisfaction (Appendix B, Table B.4). Satisfaction and dissatisfaction associated with early referral of neurological patients and amount of exposure to neurological cases does not appear to have been evaluated in medical literature. However, several studies have evaluated reasons for and methods of neurological patient referral, and the appropriateness of that referral. In medical literature, risk aversion, fear of malpractice and a tendency towards making only a narrow range of diagnoses have been linked to higher referral rates and inappropriate referrals of neurological patients (Franks et al., 2000; Gentile et al., 2020). High medicolegal risk and patient and family expectations (and subsequent referral pressure) could hinder physicians’ willingness to directly engage with clinical neurology, and consequently limit the ability to gain experience and confidence. Other studies have also noted general practitioners’ lack of clinical involvement in neurological cases, suggesting little clinical neurology experience is gained (Bekkelund & Albretsen, 2002; Gentile et al., 2020; Wiles & Lindsay, 1996). However, positive effects of experience have been noted as well: general practitioners were more resistant to referral when they were confident in their level of experience with neurological cases and more tolerant of uncertainty (Morgan et al., 2007).

This study aimed to establish foundational differences between veterinarians with clearly negative attitudes toward neurology and veterinarians with clearly positive attitudes toward neurology. Participants reporting indifference were excluded from the primary analysis to sharpen this contrast and provide initial insight into the extremes of the attitudinal spectrum. However, this approach also limited our understanding of moderate or transitional perspectives, which may play a key role in shaping attitudes. While data from the indifferent group were collected and could support further exploration, a detailed investigation of moderate or transitional perspectives was considered beyond the scope of this initial study. The focus of this research was to first clarify what characterises strongly negative *versus* strongly positive attitudes towards neurology, before addressing more nuanced variations. A follow-up analysis targeting the perspectives of indifferent respondents is feasible and warranted, and may help identify factors that shape changes in attitude over time or suggest alternate considerations for educational intervention.

The number of respondents in this study was insufficient to perform robust multivariable analyses. Limited sample size across comparison groups restricted statistical power and prevented meaningful exploration of interaction effects or adjustment for potential confounding variables. As a result, the analysis was necessarily limited to descriptive and univariable approaches and findings should be interpreted with caution, as the observed associations may not reflect independent effects. Future research with a larger sample would allow for a more detailed examination of how multiple factors influence veterinarians' attitudes toward neurology.

The mindset scale used in this study was an adapted version of a longer, validated instrument. A 5-point format was selected to offer a neutral response option and reduce respondent fatigue, given the overall length of the questionnaire (see Appendix A, Rationale for adjustments made to the mindset scale). However, this adaptation reduced comparability with prior studies that used the full instrument and a 4-point scale (for example, Armitage-Chan & Maddison, 2019; Atwood, 2010). These changes may also have influenced the distribution of responses, particularly for participants with borderline mindset orientations. While internal consistency was observed, future research would benefit from using the full version of the instrument and standardised scaling practices to enhance interpretability and alignment with existing literature.

5.5 Conclusion

Within this cohort of veterinarians, most veterinarians disliked/avoided neurology and/or believed that most veterinarians disliked neurology. The traits perfectionism, level of tolerance of uncertainty and mindset were reflected in many of the significant findings and trends identified in the current survey. Although surveyed respondents with differing attitudes towards neurology tended to have similar professional priorities, mismatch or alignment of neurological experiences and professional priorities might still occur and affect the individual's emotional response to their experiences. Data suggested that most differences in perspectives between veterinarians who disliked/avoided neurology and veterinarians who enjoyed neurology traits were due to differences in personality traits and associated affective responses.

6 Student Insights: A Quantitative Evaluation of Veterinary Student's Perspectives of Neurology

6.1 Introduction

In Chapter 5, veterinarians' undergraduate experiences often shaped their perspectives of a subject. Although their perspectives could change over time, veterinarians' early preferences and prejudices could influence their perceptions of later experiences and affect willingness to engage in later experiences.

In the qualitative arm of this thesis (see Chapter 4), many interviewed veterinarians expressed general feelings regarding their undergraduate experiences of learning neurology but commented on difficulty remembering specific details of what contributed to undergraduate experiences and perspectives. Furthermore, recollections could have been affected by current perspectives and interpretations of events, thereby failing to reflect the affective responses the individual actually experienced at the time. Changing curriculums, staff, and methods of educational delivery, as well as changes in contextual factors such as social norms and expectations, meant that the experiences of past undergraduates may not reflect those of current veterinary undergraduate students. In this third phase of my research, undergraduate veterinary students were surveyed to investigate their perspectives of neurology and experiences learning neurology.

One of my research questions is to discover what social and contextual factors inform veterinarians' perspectives of neurology. I also wished to explore veterinarians' experiences of learning neurology, when a veterinarian's perception of neurology is formed and whether it changes, how the development of perceptions of neurology compares to the development of perceptions of other medical disciplines, and whether there are common influences or mindsets that encourage veterinarians' preferences. The quantitative study discussed in this chapter sought to elucidate current undergraduate veterinary students' experiences learning neurology and how these experiences compare to learning other medical disciplines. It explored social and contextual factors that may inform veterinary students' perspectives and common mitigating factors that may encourage veterinary students' preferences. In particular, it examined differences in personality factors and affective responses as potential influences on individuals' perspectives of neurology when encountering difficulty learning the subject. In Chapter 7, the findings will be used to develop a model proposing possible contributors to negative and positive attitudes towards neurology.

6.2 Research Method

An online survey of undergraduate veterinary students was conducted. The survey questions were informed by the findings of the analysis undertaken in the qualitative arm of this thesis (Chapter 4) and review of medical literature on "neurophobia" (Figure 2.2). The questionnaire was administered using Qualtrics[6] and was open for 4 weeks.

6.2.1 Recruitment

In Semester 2 of 2022, all veterinary students enrolled in the Bachelor of Veterinary Science (BVSc) programme at Massey University were invited to complete an anonymous online questionnaire exploring their perspectives of neurology and experiences learning neurology-based subjects. Although the questionnaire was assessing perspectives not competency and interview findings (see Chapter 4) suggested similar perspectives of neurology amongst veterinarians trained in other countries, this survey did pose potential reputational risk to the veterinary school. Written permission to conduct the research was therefore sought and obtained from the Head of the School of Veterinary Science.

Due to my position as a clinical lecturer, it was essential to protect respondent anonymity, minimise any perceived imbalance of power and minimise potential social desirability bias caused by students providing tactful rather than true perspectives. The following measures were taken to de-identify respondents and reduce perceived imbalance of power: students were explicitly advised all data would be handled in ways that maintained anonymity; completion of the questionnaire was voluntary; the questionnaire was distributed after most neurology content had been formally assessed; students were contacted by an administrator via an email listserver and received a reminder email two weeks later; while respondents who completed the questionnaire could choose to enter a prize draw, the email addresses of respondents who entered the prize draw were only accessed by an administrator.

6.2.2 Questionnaire

A complete version of the student questionnaire is provided in Appendix A: Systematic Review, Interview and Survey Information. The questionnaire was divided into eight sections: baseline information, perspectives of neurology, how neurology compared to other disciplines, experiences learning neurology, motivation to learn, aspects of veterinary practice that are important to the

[6] Qualtrics. (2020) (Version October, 2022). Provo, Utah, USA: Qualtrics. Retrieved from https://www.qualtrics.com

respondent, measures of perfectionism, and tolerance of uncertainty. Respondents may not have been asked all questions—follow-up questions depended on answers provided. The questionnaire combined open- and closed-ended questions, including Likert scales, ranking questions, and selecting items from lists. The questionnaire was approved by the Massey University Human Ethics Committee (SOA 22/29).

The first section collected baseline data including gender, age, year of undergraduate veterinary study, and the veterinary sector the respondent planned to enter following graduation.

Perspectives of neurology

In the second section, respondents were questioned about their perspectives of neurology. Respondents were also questioned about their previous experience of neurological disease in humans and animals.

How neurology compared to other disciplines

In the third section, respondents were questioned about the categories of subjects they most enjoyed and most disliked. Respondents were then asked to indicate how well their stated reasons applied to neurology. Comparisons of reasons a discipline was enjoyed or disliked were subsequently collapsed into the categories "*Applies less or does not apply to neurology*" and "*Applies more to neurology or to the same degree*".

Experiences learning neurology

In the fourth section, respondents were questioned about their perspectives of neurology and experiences learning neurology, including aspects of neurology they enjoyed, found easy, and found difficult. Respondents were questioned about their method of studying neurology and their perceived retention of what they had learned. Respondents answered questions intended to evaluate fixed *versus* growth mindset based on the approach of Armitage-Chan and Maddison (2019). Higher scores in the mindset scale indicate more of a growth mindset, while lower scores indicate more of a fixed mindset. Due to questionnaire length and applicability of findings, Armitage-Chan and Maddison's (2019) full scale was not employed (see Appendix A for details and Table A.2 for the adapted questions).

Motivation to learn

In the fifth section, respondents were asked about their general motivation to learn and study and their approach to study of perceived difficult subjects.

Aspects of veterinary practice that are important to the respondent

In the sixth section, respondents were asked a series of questions to identify elements of clinical practice they considered important. To understand how respondents defined their professional identity, they were asked to select three statements that best defined the role and requirements of a veterinarian. These statements were based on the findings of previous investigations into veterinary professional identity (for example, Armitage-Chan, Maddison and May, (2016). To understand what was important to each student, respondents were asked to rank 10 different case management priorities from most (1) to least (10) important. Rankings 1-3 were collapsed to form the category *most important priorities* and rankings 8-10 were collapsed to form the category *least important priorities*. Respondents were also asked to select 1-3 listed factors that caused them the greatest emotional difficulty.

Measures of perfectionism

In the seventh section, respondents were asked to complete the 24-item adaptation of the Frost Multidimensional Perfectionism Scale (FMPS-24) (Khawaja & Armstrong, 2005) (see Appendix A: Systematic Review, Interview and Survey Information). As discussed in Chapter 5, the FMPS-24 scale includes questions evaluating four subscales. Concerns over Mistakes and Doubts about Actions and Parental Expectations and Parental Criticism are linked to maladaptive perfectionism; Organisation and Personal Standards are linked to adaptive perfectionism. Higher scores indicate greater levels of each type of perfectionism. Total Perfectionism scores are calculated as the sum of all the subscale scores except Organisation. The Organisation subscale score is not included in the Total Perfectionism score as organisation is not considered to be intrinsically problematic. However, a high Organisation subscale score can exacerbate other aspects of perfectionism.

Tolerance of uncertainty

Finally, respondents were asked to complete the Intolerance of Uncertainty scale (Buhr & Dugas, 2002) adapted to focus responses on uncertainty relating to neurology (see Appendix A: Systematic Review, Interview and Survey Information). As discussed in Chapter 5, I elected to adapt a pre-existing instrument to focus the respondent on their reactions towards uncertainty in neurology because intolerance of uncertainty appears to be malleable (Carnahan et al., 2022; Shapiro et al., 2020), and the focus of my research was specific to neurology. This adaptation was also intended to counter any variation in tolerance of uncertainty due to risk aversion and perceptions of risk associated with neurology. To minimise effects on validity, changes to question wording were limited as much as possible. The wording changes are outlined in Appendix A, Table A.3.

The higher the score in the Intolerance of Uncertainty scale, the less tolerant the individual is of uncertainty.

6.2.3 Data analysis

Respondents were unable proceed with the questionnaire if they did not indicate their attitude toward neurology. Responses to the question "What is your overall view of neurology?" were collapsed into three categories: *Disliked/avoided neurology, Indifferent to neurology* and *Enjoyed neurology*. Respondents who were indifferent to neurology or who had not yet formed an opinion were subsequently excluded from the analysis. As discussed in Chapter 5, the decision to exclude those indifferent to neurology allowed data analysis to focus on understanding the differences between participants with the extremes in the spectrum of attitude towards neurology, in order to help establish initial themes or hypotheses. Excluding the indifferent respondents risked loss of the nuance that may be obtained from understanding the moderate or transitional perspective. However, this study aimed to identify factors that differed between veterinary students with clearly negative attitudes towards neurology and those with clearly positive attitudes towards neurology, and loss of nuance was considered a valid trade-off for greater clarity in understanding of extreme attitudes at this early stage in the research.

Descriptive statistics were primarily employed to evaluate the data. Categorical responses were collapsed for analysis when numbers were low or when responses aligned with others to form an overarching theme.

Comparison of categorical responses from survey respondents with negative (*Disliked/avoided neurology*) or positive (*Enjoyed neurology*) attitudes towards neurology was undertaken using either Pearson's Chi-squared test or Fisher's exact test. Prevalence ratio and 95% confidence intervals were then calculated for response categories in which significant differences were detected. Differences between the two response categories in their scores of the Multidimensional Perfectionism Scale (FMPS-24), the adapted Intolerance of Uncertainty scale, the adapted mindset scale, and responses provided by sliding scales were evaluated via the Kruskal-Wallis ANOVA test. For all statistical tests, differences were considered significant at $p < 0.05$.

Statistical analysis was undertaken using R statistical software (R Core Team, 2022).

6.3 Results

There were 169 respondents in total: a response rate of 26% (169 of 642 veterinary students; 19 of 140 1st-year students, 26 of 126 2nd-year students, 27 of 129 3rd-year students, 42 of 124 4th-year students, 37 of 123 5th-year students). Eighteen respondents had not yet formed an opinion of neurology, and 51 respondents were indifferent to neurology; these participants were excluded from further analysis. The final data set for analysis comprised 100 respondents, 51 (51%) who disliked/avoided neurology and 49 (49%) who enjoyed neurology. Most respondents were female, 21-30 years old, in the 4th year of the 5-year BVSc programme, planned to enter mixed animal practice, and had no previous experience of neurological disease (Table 6.1).

Table 6.1 Demographic information for survey respondents stratified by their attitude to neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a]

	Number (%)[b]		
Variable	Disliked/avoided	Enjoyed	*P*
Gender (*n* = 100)			0.85
Female	43 (84%)	42 (86%)	
Male	7 (14%)	5 (10%)	
Another gender	1 (2%)	2 (4%)	
Age (*n* = 99)			**0.04**
<20 years old	3 (6%)	12 (24%)	
21-30 years old	41 (82%)	32 (65%)	
>30 years old	6 (12%)	5 (10%)	
Year of BVSc programme (*n* = 100)			**<0.01**
1st year	2 (4%)	9 (18%)	
2nd year	3 (6%)	11 (22%)	
3rd year	6 (12%)	7 (14%)	
4th year	25 (49%)	9 (18%)	
5th year	15 (29%)	13 (27%)	
Planned career path (*n* = 99)			**0.03**
Mixed practice	26 (52%)	13 (27%)	
Small animal practice	12 (24%)	14 (29%)	
Not yet determined	6 (12%)	12 (24%)	
Exotic animal species and/or wildlife	2 (4%)	3 (6%)	
Production animals	2 (4%)	3 (6%)	
Equine	0 (0%)	4 (8%)	
Non-clinical	2 (4%)	0 (0%)	
Previous experience of neurological disease (*n* = 99)			
Experience of neurological disease in an animal(s)			0.9
Yes	22 (44%)	20 (41%)	
No	28 (56%)	29 (59%)	
Experience of neurological disease in a human(s)			0.6
Yes	14 (28%)	17 (35%)	
No	36 (72%)	32 (65%)	

[a]Of those that disliked/avoided neurology, data were missing from one respondent for each of: age, planned career path, and previous experience of neurological disease or neurology cases.

[b]Percentages reflect the proportion of respondents in each attitude category.

P-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Due to rounding percentages may not equal 100.

6.3.1 Perspectives of neurology

Respondents' perceptions of neurology are described in

Table 6.2. Compared to respondents who enjoyed neurology, respondents who disliked/avoided neurology were more likely to describe neurology as overwhelming, find neurology scary and emotionally draining, and believe neurological disease is difficult to investigate in animals.

Fifty-six survey respondents had experience of neurological disease in humans or animals; 28 who disliked/avoided neurology and 28 who enjoyed neurology (Table 6.3 Respondents' perceptions of their experience of neurological disease in humans and/or animals and the prevalence ratio of disliking/avoiding neurology. Data from 56 survey respondents who had experience of neurological disease; 28 who disliked/avoided neurology and 28 who enjoyed neurologya.). Most respondents felt the experience did or possibly affected their view of neurology. Respondents whose experience of neurological disease made them wish to better understand neurology were significantly less likely to dislike/avoid neurology than enjoy neurology (p = 0.03). Respondents whose experience of neurological disease had a positive influence on their view of neurological disease and neurology were significantly less likely to dislike/avoid neurology than enjoy neurology (p <0.01).

Respondents with experience of neurological disease only in humans were compared to respondents with experience of neurological disease only in animals (Appendix B, Table B.8). Respondents who felt their experience of neurological disease showed neurological disease is unfair were significantly more likely to have experience of neurological disease only in humans than only in animals (p = 0.003). Respondents whose experience had both positive and negative influences on their view of neurological disease/neurology were significantly more likely to have experience of neurological disease only in humans than only in animals (p = 0.01).

Table 6.2 Respondents' perceptions of neurology as a subject and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
The best descriptor of neurology (*n* = 100)			**<0.001**	
Overwhelming	24 (47%)	5 (10%)		REF
Challenging (in a good way)	1 (2%)	17 (35%)		5.17 [2.07, 12.89]
Interesting	4 (8%)	21 (43%)		14.90 [2.20, 100.80]
Difficult to understand	8 (16%)	0 (0%)		0.83 [0.70, 0.98]
Hard to remember	8 (16%)	0 (0%)		0.83 [0.70, 0.98]
I find neurology scary (*n* = 75)			**<0.001**	
Agree or strongly agree	32 (80%)	6 (17%)		REF
Strongly disagree or disagree	2 (5%)	17 (49%)		8.00 [2.14, 29.89]
Somewhat agree	6 (15%)	12 (34%)		2.53 [1.30, 4.93]
Neurological cases are emotionally draining (*n* = 72)			**0.04**	
Agree or strongly agree	19 (49%)	7 (21%)		REF
Strongly disagree or disagree	9 (23%)	14 (42%)		1.87 [1.07, 3.27]
Somewhat agree	11 (28%)	12 (36%)		1.53 [0.94, 2.49]
Little can be done for animals with neurological disease (*n* = 67)			0.91	
Agree or strongly agree	8 (23%)	6 (19%)		REF
Strongly disagree or disagree	17 (49%)	16 (50%)		1.11 [0.63, 1.94]
Somewhat agree	10 (29%)	10 (31%)		1.14 [0.61, 2.15]
I find neurology fascinating (*n* = 57)			**<0.001**	
Agree or strongly agree	11 (41%)	26 (87%)		REF
Strongly disagree or disagree	11 (41%)	0 (0%)		0.30 [0.18, 0.49]
Somewhat agree	5 (19%)	4 (13%)		0.54 [0.25, 1.15]
It is difficult to investigate neurological disease in animals (*n* = 72)			0.93	
Agree or strongly agree	15 (38%)	14 (42%)		REF
Strongly disagree or disagree	7 (18%)	6 (18%)		0.96 [0.52, 1.77]
Somewhat agree	17 (44%)	13 (39%)		0.91 [0.57, 1.46]

[a]Of those that disliked/avoided neurology, data were missing for finding neurology scary (*n* = 11), emotionally draining (*n* = 12) and fascinating (n = 24), belief little could be done for animals with neurological disease (n = 16), and it is difficult to investigate neurological disease in animals (*n* = 12). Of those that enjoyed neurology, data were missing for finding neurology scary (*n* = 14), emotionally draining (*n* = 16) and fascinating (n = 19), belief little could be done for animals with neurological disease (n = 17), and it is difficult to investigate neurological disease in animals (*n* = 16).

*Percentages reflect the proportion of respondents in each attitude category.

REF = reference statement for prevalence ratio calculation.

Due to rounding percentages may not equal 100.

Table 6.3 Respondents' perceptions of their experience of neurological disease in humans and/or animals and the prevalence ratio of disliking/avoiding neurology. Data from 56 survey respondents who had experience of neurological disease; 28 who disliked/avoided neurology and 28 who enjoyed neurology[a].

Variable	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
What stood out most from the experience (*n* = 51)			0.39	
Helped with understanding of neurology	6 (25%)	7 (26%)		REF
Motivated to learn more	5 (21%)	7 (26%)		1.11 [0.45, 2.70]
Emotionally difficult situation	4 (17%)	4 (15%)		0.92 [0.37, 2.29]
Found confusing	2 (8%)	2 (7%)		0.92 [0.29, 2.89]
Found interesting	1 (4%)	5 (19%)		2.77 [0.42, 18.20]
Found stressful	3 (13%)	1 (4%)		0.62 [0.27, 1.39]
Found frustrating	3 (13%)	0 (0%)		0.46 [0.26, 0.83]
Emotionally rewarding situation	0 (0%)	1 (4%)		NC
Experience affected view of neurology (*n* = 55)			0.21	
Yes	8 (29%)	14 (52%)		REF
Maybe	17 (61%)	11 (41%)		0.60 [0.32, 1.12]
No	3 (11%)	2 (7%)		0.61 [0.25, 1.50]
Experience helped understanding of neurology (*n* = 51)			0.05	
Yes	9 (33%)	16 (67%)		REF
Maybe	11 (41%)	4 (17%)		0.49 [0.27, 0.90]
No	7 (26%)	4 (17%)		0.57 [0.28, 1.13]
How experience influenced view of neurology (*n* = 50)				
Wish to better understand[e]	13 (52%)	21 (84%)	**0.03**	0.51 [0.31, 0.85]
Can make positive differences to patient lives[c]	5 (20%)	12 (48%)	0.07	0.49 [0.22, 1.07]
Increased interest[c]	6 (24%)	13 (52%)	0.08	0.52 [0.25, 1.06]
Showed we can improve or cure neurological disease[c]	4 (16%)	9 (36%)	0.20	0.54 [0.23, 1.28]
Put off learning more about neurology[d]	3 (12%)	0 (0%)	0.23	2.14 [1.58, 2.90]
Showed little can be done[d]	7 (28%)	5 (20%)	0.74	1.23 [0.69, 2.21]
Showed neurological diseases are life-altering[e]	15 (60%)	13 (52%)	0.78	1.18 [0.66, 2.09]
Showed neurological diseases are unfair[d]	7 (28%)	6 (24%)	1	1.11 [0.61, 2.02]
How experience influenced view of neurology (*n* = 50)				
Positive influences selected	10 (40%)	20 (80%)	**<0.01**	0.44 [0.25, 0.78]
Both positive and negative influences selected	3 (12%)	7 (28%)	0.29	0.55 [0.20, 1.46]
Influences may be a neutral statement	17 (68%)	21 (84%)	0.32	0.67 [0.39, 1.14]
Negative influences selected	12 (48%)	8 (32%)	0.39	1.38 [0.80, 2.38]

[a]Of those that disliked/avoided neurology, data were missing for what stood out most from the experience (*n* = 5), whether the experience helped understanding of neurology (*n* = 1) and how the experience influenced their view of neurology (n = 5). Of those that enjoyed neurology, data were missing for what stood out most from the experience (*n* = 1), whether the experience affected their view of neurology (*n* = 1) or helped understanding of neurology (*n* = 4) and how the experience influenced their view of neurology (n = 3).

[b]Percentages reflect the proportion of respondents in each attitude category.

Influence on neurology: [c] positive, [d] negative, [e] may be a neutral statement.

NC = Not able to calculate because of zero values.

REF = reference statement for prevalence ratio calculation.

When multiple variables could be selected for the question, *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Due to rounding percentages may not equal 100.

6.3.2 How neurology compared to other disciplines

Most respondents enjoyed the subject categories pathology (33 of 90 respondents; 37%) and clinical disciplines (21 of 90 respondents; 23%). Reasons respondents preferred a subject are provided in Table 6.4. Respondents who disliked/avoided neurology were most likely to enjoy subjects because they understood them, the lecturers made the subjects interesting or enjoyable, and they were fascinating.

Statements suggesting focus on learning or outcome as reasons for subject enjoyment are indicated in Table 6.4. Statements indicating challenge or interest were selected more frequently by respondents who enjoyed neurology, while statements indicating ease of understanding or learning were selected more frequently by respondents who disliked/avoided neurology. Selection of at least one statement that suggested focus on learning was significantly less likely among respondents who disliked/avoided neurology than respondents who enjoyed neurology ($p < 0.01$).

Statements suggesting internal or external motivation as reasons for subject enjoyment are indicated in Table 6.4. Selection of at least one statement that suggested internal motivation was significantly less likely amongst respondents who disliked/avoided neurology than respondents who enjoyed neurology ($p < 0.01$).

All respondents who disliked/avoided neurology and enjoyed their preferred subject because it was challenging or because they understood it, reported these reasons for enjoyment applied less to neurology Table 6.6. All respondents who enjoyed neurology and enjoyed their preferred subject because it was challenging, reported they enjoyed the challenge of neurology as much, or more. Respondents who felt the following reasons they enjoyed their preferred subject applied less to neurology were significantly more likely to dislike/avoid neurology: "I find them fascinating" ($p <0.001$), "I like how challenging they are" ($p <0.01$), "I understand them" ($p = 0.02$).

Most respondents least enjoyed professional practice subjects (43 of 89 respondents; 48%) or basic sciences (19 of 89 respondents; 21%). Most respondents who disliked/avoided neurology disliked their least enjoyed subject because they found it boring or difficult to learn or remember (Table 6.5). No respondent who enjoyed neurology disliked their least enjoyed subject because it was challenging.

All respondents who disliked their least enjoyed subject because they were not confident in their ability to do well felt this statement applied as much or more to neurology (Table 6.7). All respondents who disliked/avoided neurology and disliked their least enjoyed subject because it was difficult to learn or remember, they did not like how challenging it was, and they got worse grades, reported these statements applied as much or more to neurology.

Table 6.4 Reasons respondents enjoyed their preferred subject and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a]

	Variable	Disliked/avoided *n* (% of 46)	Enjoyed *n* (% of 41)	*P*	Prevalence ratio [95% CI]
Internal motivation	I like how challenging they are[b]	5 (11%)	12 (29%)	0.06	0.50 [0.23, 1.08]
	They make me feel like I am making progress to becoming a vet[c]	10 (22%)	17 (41%)	0.08	0.62 [0.36, 1.05]
	I find them fascinating[b]	16 (35%)	22 (48%)	0.12	0.69 [0.45, 1.06]
External motivation	The workload is appropriate	10 (22%)	1 (2%)	**0.02**	1.92 [1.42, 2.60]
	The lecturers make the subjects easy to understand	12 (26%)	3 (7%)	**0.04**	1.69 [1.19, 2.41]
	They are relevant to my planned career[c]	8 (17%)	12 (29%)	0.29	0.71 [0.40, 1.25]
	The lecturers make the subjects interesting and/or enjoyable	16 (35%)	18 (44%)	0.52	0.83 [0.54, 1.27]
Outcome focus	I understand them	17 (37%)	6 (15%)	**0.03**	1.63 [1.14, 2.34]
	I find them easy to learn or remember	11 (24%)	4 (10%)	0.14	1.51 [1.02, 2.22]
Neutral statement	I can visualise or see the concepts that I am learning	11 (24%)	17 (41%)	0.13	0.66 [0.40, 1.10]
	Selection of at least one statement				
	Internal motivation	26 (57%)	35 (85%)	**<0.01**	0.55 [0.39, 0.79]
	External motivation	34 (74%)	29 (71%)	0.93	1.08 [0.68, 1.71]
	Learning focus	18 (39%)	29 (71%)	**<0.01**	0.55 [0.36, 0.83]
	Outcome focus	38 (83%)	31 (76%)	0.59	1.24 [0.71, 2.17]

[a] Data were missing from 5 respondents who disliked/avoided neurology and 8 respondents who enjoyed neurology.
[b]Statements suggested learning focus.
[c]Statements suggested outcome focus. Additional statements included: "I get good grades in these subjects", "I feel confident in my performance in the subject", and "They make me feel good about myself"
Multiple variables could be selected for the question. *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.
Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

Table 6.5 Reasons respondents disliked their least enjoyed subject and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 46)	Enjoyed *n* (% of 41)	*P*	Prevalence ratio [95% CI]
I find them boring	19 (41%)	29 (71%)	**0.01**	0.57 [0.38, 0.86]
I do not know which parts are important to learn	14 (30%)	13 (32%)	1	0.97 [0.63, 1.50]
The lecturers make the subjects uninteresting and/or unenjoyable	14 (30%)	12 (29%)	1	1.03 [0.67, 1.58]
I find them difficult to learn or remember	16 (35%)	6 (15%)	0.06	1.58 [1.09, 2.27]
I cannot visualise or see the concepts that I am learning	11 (24%)	12 (29%)	0.75	0.87 [0.54, 1.42]
The lecturers make the subjects harder to understand	10 (22%)	7 (17%)	0.78	1.14 [0.72, 1.81]
I have difficulty understanding them	11 (24%)	4 (10%)	0.14	1.51 [1.02, 2.22]
I am not confident in my ability to do well in the subjects	8 (17%)	3 (7%)	0.28	1.45 [0.95, 2.23]
The workload is too high	6 (13%)	5 (12%)	1	1.04 [0.58, 1.85]

[a] Data were missing from 5 respondents who disliked/avoided neurology and 8 respondents who enjoyed neurology.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

Table 6.6 The prevalence ratio that the reason a respondent enjoyed a preferred subject applied less to neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (%)		Enjoyed *n* (%)			Prevalence ratio [95% CI] statement applied less or did not apply
	Applies less/ does not apply	Applies the same/more	Applies less/ does not apply	Applies the same/more	*P*	
I find them fascinating	7 (64%)	4 (35%)	0 (0%)	14 (100%)	**<0.001**	4.50 [1.90, 10.68]
I like how challenging they are	3 (100%)	0 (0%)	0 (0%)	9 (100%)	**<0.01**	NC
I understand them	11 (100%)	0 (0%)	2 (40%)	3 (60%)	**0.02**	NC
I find them easy to learn or remember	8 (100%)	0 (0%)	1 (33%)	2 (67%)	0.05	NC
The lecturers make the subjects interesting and/or enjoyable	8 (80%)	2 (20%)	8 (53%)	7 (47%)	0.23	2.25 [0.60, 8.40]
They make me feel like I am making progress to becoming a vet	2 (29%)	5 (71%)	1 (8%)	12 (92%)	0.27	2.27 [0.76, 6.72]
I can visualise or see the concepts that I am learning	5 (83)	1 (17%)	6 (50%)	6 (50%)	0.32	3.18 [0.46, 21.85]
They are relevant to my planned career	2 (25%)	6 (75%)	2 (20%)	8 (80%)	1	1.17 [0.37, 3.69]
The lecturers make the subjects easy to understand	6 (75%)	2 (25%)	2 (67%)	1 (33%)	1	1.12 [0.46, 2.75]

[a]Data were missing from 8 respondents who disliked/avoided neurology and 9 respondents who enjoyed neurology - three respondents who disliked/avoided neurology and one respondent who enjoyed neurology did not indicate how the reasons they enjoyed their preferred discipline applied to neurology.

Percentages represent the proportion of respondents in each attitude category who chose the response. *P*-values were calculated comparing the number of respondents that selected the "applies less/does not apply" variable to the number that selected the "applies the same/more" variable.

NC = Not able to calculate because of zero values.

Statements initially selected by fewer than 10 respondents were excluded from the table due to low numbers.

Due to rounding percentages may not equal 100.

Table 6.7 The prevalence ratio that the reason a respondent disliked a least enjoyed subject applied to the same degree or more to neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (%)		Enjoyed *n* (%)			Prevalence ratio [95% CI]
	Applies less/ does not apply	Applies the same/more	Applies less/ does not apply	Applies the same/more	*P*	statement applied less or did not apply
I find them difficult to learn or remember	0 (0%)	11 (100%)	2 (50%)	2 (50%)	0.06	NC
I do not know which parts are important to learn	1 (11%)	8 (89%)	5 (50%)	5 (50%)	0.14	3.69 (0.59, 23.25)
I cannot visualise or see the concepts that I am learning	2 (33%)	4 (67%)	4 (44%)	5 (56%)	0.61	1.33 (0.35, 5.13)
I find them boring	9 (90%)	1 (10%)	19 (90%)	2 (10%)	1	1.04 (0.19, 5.61)
The lecturers make the subjects uninteresting and/or unenjoyable	7 (88%)	1 (13%)	8 (80%)	2 (20%)	1	0.71 (0.13, 3.87)
The lecturers make the subjects harder to understand	4 (50%)	4 (50%)	1 (33%)	2 (67%)	1	0.83 (0.41, 1.70)
I have difficulty understanding them	3 (38%)	5 (63%)	1 (33%)	2 (67%)	1	0.95 (0.46, 1.99)

[a]Data were missing from 10 respondents who disliked/avoided neurology and 10 respondents who enjoyed neurology - five respondents who disliked/avoided neurology and two respondents who enjoyed neurology did not indicate how the reasons they disliked their least preferred discipline applied to neurology.

Percentages represent the proportion of respondents in each attitude category who chose the response. *P*-values were calculated comparing the number of respondents that selected the "applies the same/more" variable to the number that selected the "applies less/does not apply" variable.

NC = Not able to calculate because of zero values.

Statements initially selected by fewer than 10 respondents were excluded from the table due to low numbers.

Due to rounding percentages may not equal 100.

6.3.3 Experiences learning neurology

Respondents' perceptions of learning neurology are described in Table 6.8. Most respondents, regardless of their attitude towards neurology, found neurology challenging to understand and/or apply and believed neurology was relevant to their career. Compared to respondents who enjoyed neurology, respondents who disliked/avoided neurology were more likely to report either neutral or negative learning experiences of neurology. Respondents who disliked/avoided neurology were also more likely to not or only somewhat enjoy learning and/or applying neurology. Respondents who disliked/avoided neurology were most likely to feel that learning neurology made them feel "stupid" or "inadequate", it is not easy to see the link between neurological function and clinical signs, and they could not apply what they have learned to a clinical situation or know where to start when faced with a clinical case.

Some respondents had a negative perspective of neurology prior to starting their study of it (Table 6.8). Respondents who disliked/avoided neurology were most likely to report their opinion of neurology worsened because they couldn't understand it. Only respondents who disliked/avoided neurology reported their opinion changed as the result of a case (four of 40 respondents; 10%) or because neurology makes them feel bad about themselves or their abilities (four of 40 respondents; 10%).

Most respondents who disliked/avoided neurology studied neurology by trying to better understand or through memorisation (Table 6.9). Respondents who disliked/avoided neurology were most likely to feel they retained little of what they learnt about neurology and find the amount of detail and volume of material the greatest difficulty learning neurology. Regardless of their attitude towards neurology, respondents who studied to understand neurology were significantly more likely to retain some or most of what they had learned than to retain nothing or little of what they had learned ($p = 0.01$) (Appendix B, Table B. 9). Regardless of their attitude towards neurology, respondents who studied through memorisation were significantly more likely to retain little or nothing of what they had learned than to retain some or most of what they had learned ($p = 0.02$) (Appendix B, Table B. 9).

The reasons respondents chose their method of study when learning neurology are depicted in Appendix B, Table B.10. Regardless of their attitude towards neurology, most respondents studied to better understand neurology because it was their usual study method. In contrast, most respondents who studied neurology through memorisation or studied to pass the examination chose the approach because they had a lot to learn or limited time. None of the respondents who studied by memorisation indicated this was their usual approach to studying.

Most respondents, regardless of their attitude towards neurology, reported the level of detail and volume of material made learning neurology difficult (Table 6.9 and Table 6.10). Only respondents who disliked/avoided neurology reported learning neurology was difficult because the subject made them feel bad about themselves or their abilities.

In open comments, respondents linked lack of repeated exposure to neurology to difficulty cementing the basics of neurology, difficulty remembering neurology and difficulty making connections between subjects. Respondents linked insufficient time for learning to the volume of material and the effect limited time had on study approach. High workload—limited time and large volume to learn—was referenced in relation to both the neurology module and the overall curriculum. Examples of open comments relating to workload and difficulty learning neurology are provided in Appendix B, Table B.11.

Table 6.8 Respondents' perceptions of learning neurology and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
Learning experiences of neurology (*n* = 55)			**<0.001**	
Positive	6 (25%)	23 (74%)		REF
Neutral	9 (38%)	7 (23%)		0.37 [0.16, 0.85]
Negative	9 (38%)	1 (3%)		0.23 [0.11, 0.48]
Reason opinion of neurology changed during learning (*n* = 76)[¥]			**<0.001**	
I couldn't understand it	13 (33%)	2 (6%)		REF
I saw how it linked to other subjects	5 (13%)	7 (19%)		2.08 [1.03, 4.18]
My opinion has not changed	3 (8%)	13 (36%)		3.18 [1.19, 8.51]
I enjoy learning and/or applying neurology (*n* = 55)			**<0.001**	
Agree or strongly agree	4 (15%)	23 (79%)		REF
Strongly disagree or disagree	11 (42%)	1 (3%)		0.16 [0.06, 0.41]
Somewhat agree	11 (42%)	5 (17%)		0.22 [0.08, 0.56]
I find neurology challenging to understand and/or apply (*n* = 57)			0.55	
Agree or strongly agree	21 (78%)	19 (63%)		REF
Strongly disagree or disagree	2 (7%)	5 (17%)		1.84 [0.55, 6.15]
Somewhat agree	4 (15%)	6 (20%)		1.31 [0.58, 2.96]
Learning neurology makes me feel "stupid" or "inadequate" (*n* = 53)			**<0.001**	
Agree or strongly agree	18 (69%)	3 (11%)		REF
Strongly disagree or disagree	4 (15%)	13 (48%)		3.64 [1.52, 8.74]
Somewhat agree	4 (15%)	11 (41%)		3.21 [1.36, 7.57]
It is easy to see the link between neurological function and clinical signs (*n* = 56)			**<0.01**	
Agree or strongly agree	4 (15%)	14 (48%)		REF
Strongly disagree or disagree	14 (52%)	3 (10%)		0.27 [0.11, 0.66]
Somewhat agree	9 (33%)	12 (41%)		0.52 [0.19, 1.40]
I could apply neurology theory I have learned to a clinical situation (*n* = 56)			**<0.01**	
Agree or strongly agree	3 (11%)	10 (34%)		REF
Strongly disagree or disagree	19 (70%)	8 (28%)		0.33 [0.12, 0.91]
Somewhat agree	5 (19%)	11 (38%)		0.74 [0.22, 2.53]
If I saw a neurological case in a clinic, I would know 'where to start' (*n* = 56)			**0.03**	
Agree or strongly agree	6 (22%)	11 (38%)		REF
Strongly disagree or disagree	16 (59%)	7 (24%)		0.51 [0.25, 1.02]
Somewhat agree	5 (19%)	11 (38%)		1.13 [0.43, 2.98]
What I have learned is relevant to my career (*n* = 57)			0.24	
Agree or strongly agree	17 (63%)	25 (83%)		REF
Strongly disagree or disagree	5 (19%)	3 (10%)		0.65 [0.34, 1.24]
Somewhat agree	5 (19%)	2 (7%)		0.57 [0.31, 1.03]

[a]Of those that disliked/avoided neurology, data were missing for 24 respondents, except learning experiences of neurology (*n* = 27), reason opinion of neurology changed during learning (*n* = 11), and the statements that learning neurology was enjoyable or made the respondent feel "stupid" or "inadequate" (*n* = 25). Of those that enjoyed neurology, data were missing for 20 respondents, except learning experiences of neurology (*n* = 18), reason opinion of neurology changed during learning (*n* = 13), and the statements that learning neurology was challenging or was relevant to their career (*n* = 19).

[b]Percentages reflect the proportion of respondents in each attitude category.

[¥]Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

REF = reference statement for prevalence ratio calculation.

Due to rounding percentages may not equal 100.

Table 6.9 Respondents' method of studying neurology, perception of how well learned material is retained, and greatest difficulty learning neurology, and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
Method of studying neurology (*n* = 58)			**<0.01**	
Studied to try to better understand	11 (41%)	26 (84%)		REF
Focused on memorisation	10 (37%)	2 (6%)		0.36 [0.20, 0.62]
Studied only to pass the exam	6 (22%)	3 (10%)		0.45 [0.23, 0.88]
How well they retain what is learnt about neurology (*n* = 56)			**<0.001**	
Retain nothing or almost nothing	1 (4%)	0 (0%)		REF
Retain little	15 (60%)	3 (10%)		1.20 [0.98, 1.48]
Retain some	9 (36%)	16 (52%)		2.78 [1.65, 4.68]
Retain most	0 (0%)	12 (39%)		NC
Retain everything or almost everything	0 (0%)	0 (0%)		NC
Greatest difficulty learning neurology (*n* = 59)[c]			0.19	
Too much detail and/or volume of material	7 (25%)	10 (32%)		REF
Can't remember what I learn/it doesn't "stick"	5 (18%)	5 (16%)		0.82 [0.36, 1.91]
Not enough repeated exposure	3 (11%)	4 (13%)		0.96 [0.34, 2.68]

[a]Of those that disliked/avoided neurology, data were missing for method of studying neurology (*n* = 24), how well they retain what is learnt about neurology (*n* = 26), and greatest difficulty learning neurology (*n* = 23). Of those that enjoyed neurology, data were missing for 18 respondents.

[b]Percentages reflect the proportion of respondents in each attitude category.

[c]Only the 3 statements selected by the most respondents are provided in the table.

REF = reference statement for prevalence ratio calculation.

NC = Not able to calculate because of zero values.

Due to rounding percentages may not equal 100

Table 6.10 Respondents' difficulties learning neurology and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided n (% of 28)	Enjoyed *n* (% of 31)	*P*	Prevalence ratio [95% CI]
Don't understand the "basics" of neurology	15 (54%)	2 (6%)	**<0.001**	2.85 [1.76, 4.62]
Makes me feel bad about myself/my abilities	11 (39%)	0 (0%)	**<0.001**	2.82 [1.93, 4.14]
Feel not doing a good job when I try learning it	12 (43%)	3 (10%)	**<0.01**	2.20 [1.38, 3.50]
Lack of a good approach to learning it	12 (43%)	4 (13%)	**0.02**	2.02 [1.25, 3.26]
Insufficient time to learn the material	17 (61%)	14 (45%)	0.35	1.40 [0.80, 2.44]
Too much detail and/or volume of material	22 (79%)	20 (65%)	0.37	1.48 [0.73, 3.00]
Can't physically see what I'm dealing with	9 (32%)	6 (19%)	0.41	1.39 [0.81, 2.37]
Worry over making mistakes	8 (29%)	13 (42%)	0.42	0.72 [0.39, 1.35]
Can't remember what I learn/it doesn't "stick"	18 (64%)	17 (55%)	0.64	1.23 [0.70, 2.19]
Not enough repeated exposure	17 (61%)	18 (58%)	1	1.06 [0.61, 1.84]

[a] Data were missing from 23 respondents who disliked/avoided neurology and 18 respondents who enjoyed neurology. Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

The highest mindset scale score was identical for respondents who disliked/avoided neurology and those who enjoyed neurology (Figure 6.1). However, the median score was lower amongst respondents who disliked/avoided neurology (p = 0.06).

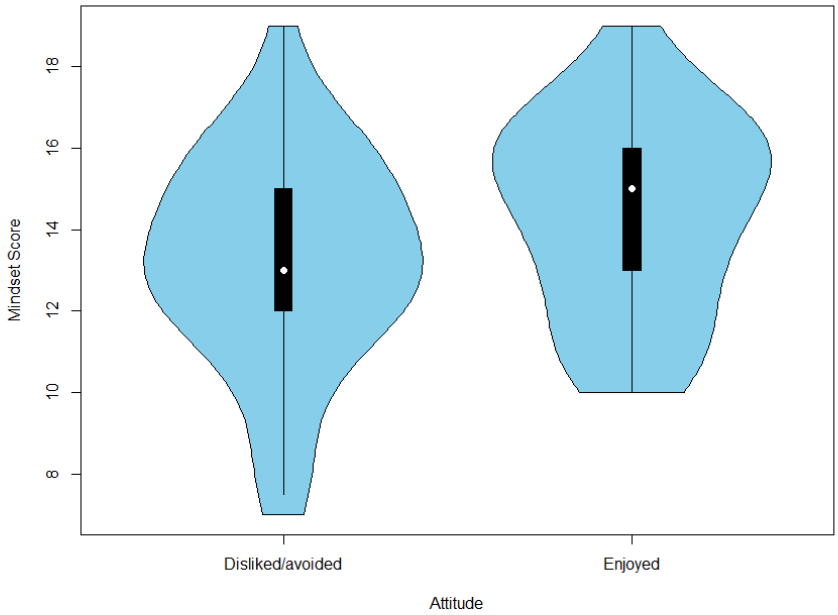

Figure 6.1 Distribution of mindset scale scores amongst respondents with different attitudes towards neurology. Data from 78 survey respondents: 41 who disliked/avoided neurology and 37 who enjoyed neurology. The violin plots depict respondents' scores for the Mindset scale; the median score was lower amongst respondents who disliked/avoided neurology (*p* = 0.06, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for the scale are 0-20. Higher scores indicate a tendency towards a growth mindset.

6.3.4 Motivation to learn

Respondents' motivations to learn and study subjects are provided in Appendix Table B, Table B.12. Regardless of attitude towards neurology, most respondents' greatest motivation was finding the subject interesting, believing it was relevant to them, or having a good teacher or enthusiastic professional model. Most respondents indicated they would devote extra time to understand difficult modules; only respondents who disliked/avoided neurology would resort to memorisation to cover the material, leave it until just before the examination, or not/barely study it. There were no significant differences between respondents who disliked/avoided neurology and those who enjoyed it.

Most respondents, regardless of their attitude towards neurology, experienced greater levels of emotional difficulty through not meeting their own expectations of themselves (Table 6.11). Only respondents who disliked/avoided neurology experienced greater levels of emotional difficulty if they did not get the "right" answer (three of 40 respondents; 8%).

Table 6.11 Factors that caused respondents greater levels of emotional difficulty and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 40)	Enjoyed *n* (% of 33)	*P*	Prevalence ratio [95% CI]
Preparing for a test/exam	16 (40%)	4 (12%)	**0.02**	1.77 [1.22, 2.55]
Being hampered by external factors (e.g. teaching, resources, time)	6 (15%)	13 (39%)	**0.04**	0.50 [0.25, 1.00]
Failing a test/exam	19 (48%)	11 (33%)	0.32	1.30 [0.86, 1.95]
Not meeting my own expectations of me	21 (53%)	21 (64%)	0.47	0.82 [0.54, 1.23]
Feeling like I am not in control	10 (25%)	11 (33%)	0.60	0.83 [0.50, 1.37]
Not meeting others' expectations of me	9 (23%)	10 (30%)	0.63	0.83 [0.49, 1.40]
Not understanding	15 (38%)	13 (39%)	1	0.96 [0.63, 1.49]
Feeling uncertain	8 (20%)	6 (18%)	1	1.05 [0.63, 1.76]

[a]Data were missing from 11 respondents who disliked/avoided neurology and 16 respondents who enjoyed neurology. Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

6.3.5 Aspects of veterinary practice that are important to the respondent

Factors respondents believed best defined the roles or requirements of a veterinarian are provided in Appendix B, Table B.13. Regardless of their attitude towards neurology, most respondents believed the roles or requirements of a veterinarian were best defined by "providing skilled animal care" and "communicating knowledge to owners so they can make choices." Respondents who disliked/avoided neurology were significantly more likely to select providing a solution for any animal health issue (p = 0.03); no respondents who enjoyed neurology selected this option.

The clinical priorities respondents deemed most and least important are provided in Appendix B, Table B.14. Regardless of their attitude towards neurology, most respondents prioritised meeting the needs of the patient, meeting the needs of the owner, and being able to explain the problem to the owner. Most respondents considered not needing to spend additional time researching a problem one of their three least important priorities. Respondents who considered appearing to know what they were talking about amongst their three least important priorities were significantly less likely to dislike/avoid neurology (p <0.01).

6.3.6 Measures of perfectionism

All questions of the FMPS-24 scale were completed by 40 respondents who disliked/avoided neurology and 33 respondents who enjoyed neurology. The median total perfectionism score was higher for respondents who disliked/avoided neurology than those who enjoyed neurology (p= 0.07) (Figure 6.2).

The total scores for each FMPS-24 subscale are depicted in Figure 6.3. The median score for the subscale Concerns over Mistakes and Doubts about Actions was significantly higher for respondents who disliked/avoided neurology than those who enjoyed neurology (p = 0.01).

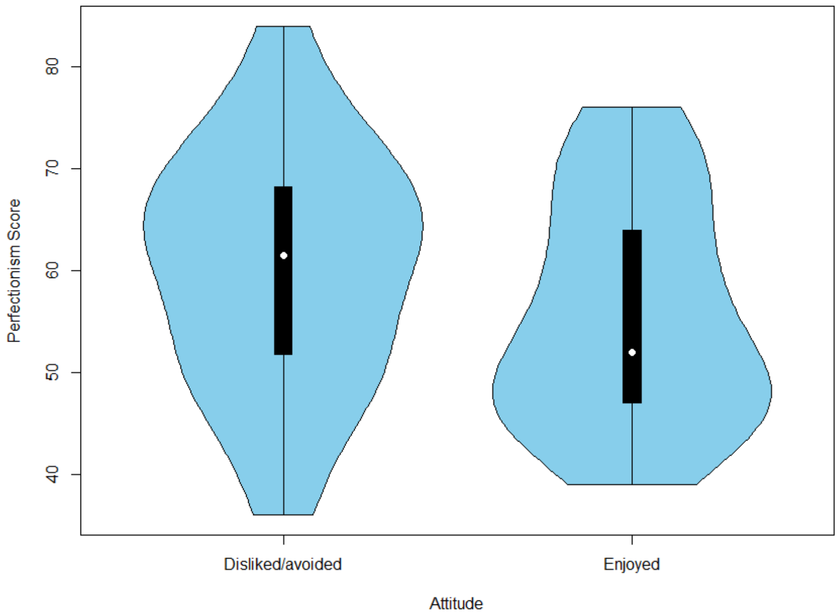

Figure 6.2 Distribution of perfectionism scale scores amongst respondents with different attitudes towards neurology. The violin plots depict respondents' total scores for the Perfectionism Scale; the median score was higher amongst respondents who disliked/avoided neurology (p = 0.07, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores range from 20-100. Higher scores indicate higher levels of perfectionism.

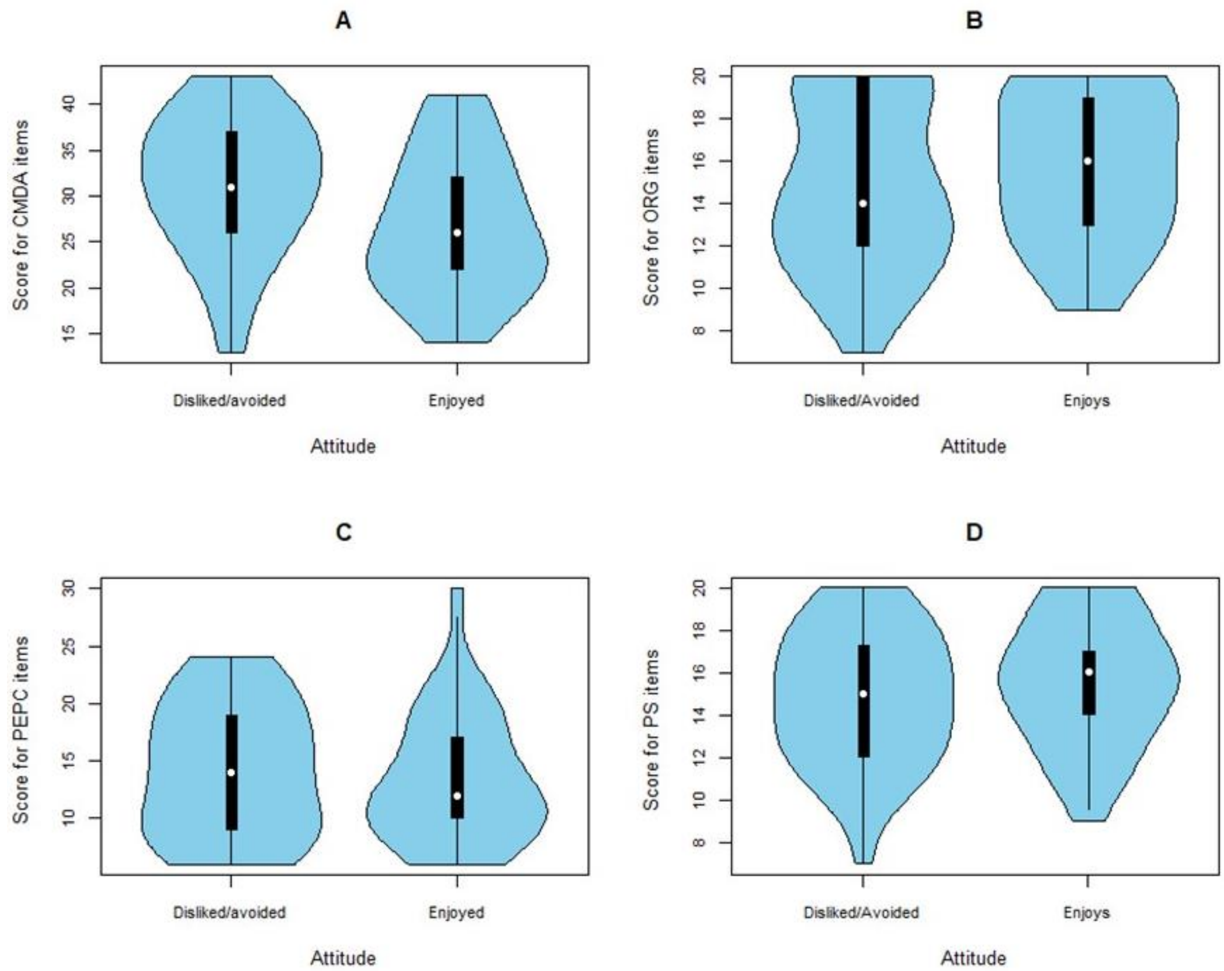

Figure 6.3 Distribution of perfectionism subscale scores amongst respondents with different attitudes towards neurology. The violin plots depict respondent scores for the Perfectionism scale subscales A) Concern over Mistakes and Doubts about Actions (CMDA) (p = **0.01**, df = 1), B) Organisation (ORG) (p = 0.44, df = 1)., C) Parental Expectations and Parental Criticism (PEPC) (p = 0.55, df = 1)., and D) Personal Standards (PS) (p = 0.38, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for each scale: 10-50 for CMDA, 6-30 for PEPC, and 4-20 for ORG and PS. Higher scores indicate higher levels of perfectionism. CMDA and PEPC = maladaptive perfectionism; ORG and PS = adaptive perfectionism.

6.3.7 Tolerance of uncertainty

The adapted Intolerance of Uncertainty scale was completed by 38 respondents who disliked/avoided neurology and 32 respondents who enjoyed neurology. The median score was significantly higher for respondents who disliked/avoided neurology than those who enjoyed neurology ($p < 0.01$)

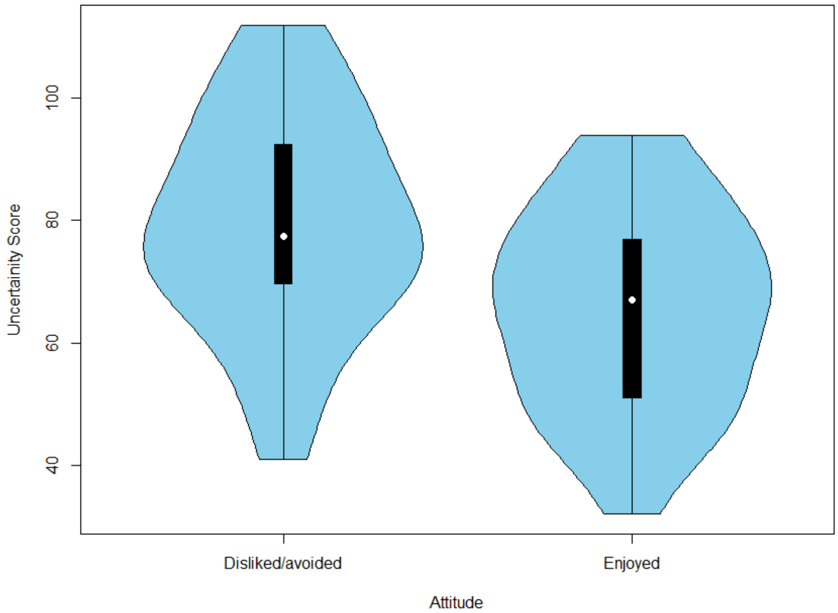

Figure 6.4 Distribution of Intolerance of Uncertainty scale scores amongst respondents with different attitudes towards neurology. The violin plots depict respondents' score for the Intolerance of Uncertainty scale; the median score was higher amongst respondents who disliked/avoided neurology ($p < 0.01$, df = 1). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores for each scale are 27-135. Higher scores indicate higher intolerance of uncertainty.

6.4 Discussion

This is the first quantitative study evaluating, in depth, veterinary students' perspectives of neurology. The primary aim of this research was to understand factors that predispose to the extremes of attitude towards neurology. Amongst the 100 respondents included in data analysis, the numbers of students who disliked/avoided and enjoyed neurology were almost equal. Regardless of their attitude towards neurology, all respondents reported intellectual difficulties—difficulties related to knowledge and understanding—with learning neurology. Key differences in intellectual difficulty were that respondents who had difficulty with the "basics" and who lacked a good approach to learning neurology were significantly more likely to dislike/avoid neurology than enjoy neurology. However, most differences between respondents who disliked/avoided neurology and those who enjoyed it related to affective responses and personality traits. Respondents who disliked/avoided neurology mostly considered neurology "overwhelming" and "scary", believed neurology cases were "emotionally draining", reported their experiences of neurology made them feel "stupid" or "inadequate", and learning neurology made them feel they were not doing a good job or caused them to feel bad about themselves and their abilities.

The differences between respondents' affective responses to difficulties encountered learning neurology may in part be associated with types and levels of perfectionism and intolerance of uncertainty. Respondents who disliked/avoided neurology were significantly less tolerant of uncertainty relating to neurology than respondents who enjoyed neurology. Uncertainty could be caused by lack of understanding, for example, uncertainty created through a lack of answers, lack of an approach to cases, and inability to see connections between clinical information and theory. As discussed in 5, uncertainty can trigger distress and negative emotions, and can relate to events that have happened, are happening, or might happen (Freeston et al., 2020) While all respondents reported intellectual difficulties learning neurology, individuals that are intolerant of uncertainty could experience greater affective consequences from difficulty understanding. When a person is intolerant of uncertainty, uncertainty may increase their anxiety and decrease their satisfaction associated with learning.

Respondents who disliked/avoided neurology scored significantly higher on the perfectionism subscale *Concern over Mistakes and Doubts about Actions*, suggesting a tendency towards the negative form of perfectionism known as maladaptive perfectionism (Khawaja & Armstrong, 2005). Furthermore, respondents who disliked/avoided neurology tended to score lower in the perfectionism subscales *Personal Standards* and *Organisation*, suggesting these respondents exhibited fewer positive aspects of perfectionism associated with goal setting, focus and efficiency (Khawaja & Armstrong, 2005). As discussed in 4 and 5, adaptive perfectionism has been associated with high personal standards and striving for perfectionism, with realistic goals and high self-efficacy helping to reduce stress (Kruger et al., 2023; Lo & Abbott, 2013; Locicero & Ashby, 2000). In contrast, maladaptive perfectionism has been linked to negative mental effects such as depression (Enns et al., 2002), and anxiety (Bieling et al., 2004)—including anxiety relating to tests and formal appraisal (Weiner & Carton, 2012). Maladaptive perfectionists are believed to be driven by fear of failure and attempts to reduce feelings of inferiority, with greater distress experienced as they try to meet their unrealistic goals (Lo & Abbott, 2013). Distress can lead to disengagement from problems or avoidance as coping methods (Weiner & Carton, 2012). In essence, while adaptive perfectionists strive to reach their ideal self, maladaptive perfectionists seek to avoid negative consequences (Slade & Owens, 1998). In the context of my research, respondents with tendencies towards maladaptive perfectionism may experience greater negative affective responses when faced with difficulty learning neurology. Difficulty learning and understanding might be perceived as failure, which could trigger the perceptions of feeling "stupid" or "inadequate" and feeling bad about themselves and their abilities. Higher maladaptive perfectionism also risks avoidance behaviour, which could reduce an individual's willingness to engage with neurology in future and risk the individual missing out on more positive experiences.

Maladaptive perfectionism has been associated with the setting of unrealistic goals (Lo & Abbott, 2013), a factor seemingly echoed by the importance some respondents who disliked/avoided neurology placed on finding answers. Providing a solution for any animal health issue was considered a key element of the role or requirements of a veterinarian amongst significantly more respondents who disliked/avoided neurology, compared to respondents who enjoyed neurology. While a commendable goal, finding a solution is often hindered by practical and theoretical limitations in clinical practice, which may leave these individuals feeling they have failed. If the prioritisation of finding answers is truly a reflection of these individuals' professional identity, failure to attain solutions to any animal health issue risks internal dissonance and negative affective responses.

Significant differences in the reasons respondents gave for enjoying or disliking a subject seemed to reflect differences in priorities and motivation. Selecting learning-focused reasons for enjoyment of their favourite subject was significantly less likely amongst respondents who disliked/avoided neurology, while outcome-focused reasons for enjoyment of their favourite subject were more common. Although enjoyment through understanding might reflect a learning focus, achieving understanding and ease of learning or remembering were categorised as outcome focused due to emphasis on the result rather than the process or reasons for gaining that understanding. The choice to categorise ease of learning or remembering as outcome-focused was in part based on literature around performance goals, as discussed by Dweck (1986). As discussed in 5, performance goals refer to an individual seeking to appear competent, meaning they preferentially choose tasks that are easy, or they believe they will succeed in. In contrast, learning goals represent an individual seeking competence and embracing challenge.

Respondents who disliked/avoided neurology expressed conditional enjoyment of challenge. The survey method of data collection prevented exploration of the reasons why these respondents did not enjoy the challenge associated with neurology as much as they did other challenge. However, as discussed in Chapter 5, conditional enjoyment of challenge could be associated with a tendency to place greater importance on outcome. Individuals might not enjoy challenge when they have difficulty achieving a perceived positive outcome despite expenditure of effort. Alternatively, enjoyment may not have come from the challenge itself, but rather success in a task others considered challenging. Success was necessary for the individual to appear competent.

Selecting internally motivated reasons for enjoyment of their favourite subject was significantly less likely amongst respondents who disliked/avoided neurology, and externally motivated reasons for enjoyment of their favourite subject were more common. Consistent with a trend towards external motivation, respondents who enjoyed a subject because lecturers made it easy to understand and they deemed the workload appropriate were almost twice as likely to dislike/avoid neurology. The survey method of data collection prevented further evaluation of these tendencies for internal *versus* external motivation. However, one explanation for some respondents' apparent reliance on external motivation is that an individual's level of interest in a topic can be influenced by ease of understanding. Wade (2001) found that students reported lower interest in texts with unfamiliar or difficult vocabulary. Essentially, confusion and incomprehension reduced interest. Unfamiliarity could be reduced if an individual possessed background information and fundamental understanding. In the context of my research, respondents who did not understand the "basics" of neurology likely struggled to comprehend learning resources. Correspondingly, these individuals may have experienced less interest and internal motivation when trying to learn neurology. In contrast, subjects they understood and were familiar with generated greater interest and enjoyment. Another explanation for a preference for perceived easier subjects relates to the motivating effects of achievement. Failure to achieve a positive outcome, such as understanding, can affect perceptions of competency, a key factor in self-motivation (Ryan & Deci, 2000). Perceived low competency can therefore decrease motivation.

There are several possible repercussions of low internal motivation. Multiple studies have demonstrated that internal motivation and interest can drive performance and persistence in situations of challenge, regardless of self-perceived ability (Fulmer & Frijters, 2011; Inoue, 2007). Conversely, a lack of interest and internal motivation can reduce persistence when undertaking a difficult task. High internal motivation can also increase willingness to invest more effort in prolonged tasks (Herlambang et al., 2021). Amongst my respondents, a tendency towards lower internal motivation and greater external motivation could have contributed to dislike of difficult subjects, such as neurology, and unwillingness to stay on task and persist to overcome the difficulties. A better understanding of how externally motivated students react to the challenge and difficulty of neurology, and what prompts their low internal motivation, could help develop educational interventions to improve attitudes towards neurology.

The focus on outcomes and higher external motivation exhibited by respondents who disliked/avoided neurology might be linked to maladaptive perfectionism and its drive to avoid failure. Failure could be considered less likely if the individual understands the subject, lecturers make the subject easy to understand, and the workload is perceived to be appropriate. Furthermore, compared to students who enjoyed neurology, a greater proportion of students who disliked/avoided neurology considered getting a definitive diagnosis, feeling in control, and attaining results quickly highly important in a clinical situation. Achieving these clinical factors would be expected to reduce concern over mistakes.

Compared to respondents who enjoyed neurology, respondents who disliked/avoided neurology tended towards maladaptive perfectionism, lower tolerance of uncertainty relating to neurology, lower internal motivation, and a greater focus on outcomes of learning than satisfaction gained from the learning itself. Additionally, respondents who considered preparing for a test or examination a cause of considerable emotional difficulty were significantly more likely to dislike/avoid neurology. Finding these traits—maladaptive perfectionism, low tolerance of uncertainty, lower internal motivation, and a focus on outcomes—in the same people makes sense. Uncertainty could increase stress for people who are afraid to fail or are worried they will be shown as inferior—especially when outcome is prioritised. While test anxiety (Bieling et al., 2004; Weiner & Carton, 2012) and intolerance of uncertainty (Huntley et al., 2020) have already been linked to maladaptive perfectionism, it is conceivable that a focus on outcomes might also contribute to test anxiety in veterinary students who disliked/avoided neurology.

Respondents who had difficulty understanding the "basics" of neurology were significantly more likely to dislike/avoid neurology. One possible reason for difficulty understanding the "basics" may be differences in study approach. Respondents who focused on memorisation were significantly more likely to dislike/avoid neurology, and significantly less likely to feel they had retained "some" or "most" of what they had learnt compared to respondents who studied to better understand. Memorisation is commonly associated with superficial learning, a learning approach that has long been recognised to result in good initial recall but poor retention (Marton & Säljö, 1976a, 1976b). Failure to retain information in the long term can not only lead to frustration but can also result in a poor knowledge base. In contrast, studying with a focus on improving understanding was chosen by more than twice the proportion of respondents who enjoyed neurology than respondents who disliked/avoided neurology. Understanding and linking of information is associated with deep learning, a learning approach that facilitates longer knowledge retention (Marton & Säljö, 1976a). Respondents who study by deep learning approaches would be expected to develop a firmer knowledge base. It should be noted that choosing a superficial approach to study neurology was typically attributed to external factors such as workload, while a deep learning approach was typically an internal choice. It should also be noted that it was the respondents themselves who provided the information regarding study approach and retention. Knowledge retention may be both over- and underestimated and affected by factors such as the amount of repetition over time. It was also possible that respondents interpreted their study method inappropriately. Further evaluation could clarify whether and how study method contributes towards attitude towards neurology. Study methods can be changed and, if a true association is present, could offer opportunity to improve attitudes towards neurology through educational intervention.

Investigations into neurophobia in medical literature have typically focused on difficulty learning or understanding the subject, while attempts to address neurophobia have usually focused on learning interventions (Abushouk & Duc, 2016; McColgan et al., 2013). The current survey results suggest that learning experiences alone were not always sufficient to change one's attitude towards neurology. An overall positive experience learning neurology was reported by one-quarter of respondents who disliked/avoided neurology and described their learning experience. Other factors must therefore contribute to some individuals' perspectives of neurology.

Some studies evaluating neurophobia in the medical profession assert that a respondent is neurophobic if they agree neurology is difficult (Chua et al., 2020; McGovern et al., 2021; Santos-Lobato et al., 2018). The word "difficult" has many connotations, including intellectual, affective, and practical, and considering something difficult does not necessarily denote one's enjoyment of it. It was inappropriate to align my questionnaire with medical literature using this vague descriptor because I wished to gain a deeper understanding of veterinary students' perspectives of neurology. Instead, elements that might be perceived as difficult were teased out, which in turn helped determine the types of difficulties respondents considered noteworthy and identified the importance of affective and intellectual difficulties when learning neurology.

To explore the suitability of attributing neurophobia to veterinary students who considered neurology difficult, respondents were asked whether they agreed with the statement "I find neurology challenging to understand and/or apply"—a statement I interpret as having similar meaning to what medical authors may have intended in their use of "difficult". Notably, amongst respondents who agreed that neurology was challenging to understand and/or apply, there was no significant difference between the numbers of respondents who disliked/avoided neurology and those who enjoyed neurology. I would therefore argue that considering neurology a challenging subject does not necessarily mean a veterinary student has a negative perspective of neurology.

In the current study, most significant differences between respondents who enjoyed neurology and those who disliked/avoided neurology related to affective responses and personality traits; however, most respondents' descriptors of neurology reflected intellectual assimilation rather than affective responses. One explanation could be that intellectual difficulty triggered affective difficulties. Individuals might therefore focus on the triggering intellectual difficulty as the primary problem. Alternatively, respondents with maladaptive perfectionism may find it easier to blame an external cause—for example, inherent difficulty of the subject—for their difficulties rather than risk feelings of personal failure. Another explanation is that individuals might be reluctant to admit to emotional difficulties. Understanding this discrepancy in attribution of perspectives will require further research.

As negative perspectives of neurology can predate admission to medical school (Fantaneanu et al., 2014), the current survey was timed to open after first year veterinary students had entered the undergraduate course in Semester 2 of 2022. Consistent with medical literature (Pakpoor et al., 2014), respondents' perspectives of neurology were influenced by personal experience of neurological disease, and the species affected by that disease (see Appendix B, Table B.8). Further evaluation is required to understand the level to which these experiences had positive and negative effects on individuals' perspectives and whether the perspectives changed over time.

Overall, attitudes towards neurology were most commonly negative at the end of 4th year after students received most of their theoretical clinical teaching—multiple respondents referenced trying to learn multiple clinical disciplines and difficulties with workload, and several referenced their dislike of the online learning platforms necessitated by COVID-19 restrictions. The proportion of respondents who regarded neurology positively was at its highest at the end of 5th year, following greater clinical application of theory and hands-on experience.

Data from participants with indifferent attitudes towards neurology were excluded from analysis to focus on factors that differentiate veterinary students with clearly negative attitudes towards neurology from those with clearly positive attitudes towards neurology. The focus of this research was to clarify what characterises strongly positive *versus* strongly negative attitudes towards neurology. Indifferent respondents were therefore excluded to sharpen the contrast between veterinary students with the extremes in attitude towards neurology and clarify what factors characterise these attitudes. However, excluding participants with moderate or transitional perspectives limited the ability to identify nuances, such as which factors have greater or lesser influence on development of attitude, and which factors modulate perspectives of experiences. A follow-up analysis targeting the perspectives of indifferent respondents is feasible and warranted, and may help identify factors that shape changes in attitude over time or suggest alternate considerations for educational intervention to encourage or aid engagement.

Care must be taken in generalisation of the survey findings. The low response rate could mean that the responses of the surveyed respondents are not representative of the entire veterinary undergraduate body. Furthermore, the results provide a snapshot; a longitudinal study would be necessary to evaluate students' development and changes in perspective over time. The findings of this study also reflect the opinions of veterinary students at a single institution; it is unknown whether comparable results would be obtained from surveys of veterinary students studying at other institutions.

The current survey explored veterinary students' perspectives and opinions; objective measures of performance were not evaluated and differences in interpretation of questions and answers is possible. For example, reporting of knowledge retention and the study approach used may not be accurate. However, subjective measures were most appropriate to answer my research questions despite the potential flaws in interpretation.

Many values, traits and experiences of neurology were shared by participants who disliked/avoided neurology and those who enjoyed neurology, indicating certain factors must modulate how each individual reacts to a shared experience. However, the number of respondents in this study was insufficient to perform robust multivariable analyses to identify such factors. Limited sample size across comparison groups restricted statistical power and prevented meaningful exploration of interaction effects or adjustment for potential confounding variables. Consequently, the analysis was, by necessity, limited to descriptive and univariable approaches. Findings should therefore be interpreted with caution, as the observed associations may not reflect independent effects. Future research with a larger sample, and inclusion of student interviews to clarify cause versus effect, would allow for a more detailed exploration of how multiple factors influence veterinary students' attitudes toward neurology.

6.5 Conclusion

Within the veterinary student cohort included in the current study, the proportions of students with negative and positive attitudes towards neurology were almost equal. Intellectual difficulties and external limitations when learning neurology were similar between veterinary students who disliked/avoided neurology and those who enjoyed neurology. Although motivational factors were similar between veterinary students who disliked/avoided neurology and those who enjoyed neurology, students who disliked/avoided neurology were less likely to be motivated by internal factors and more likely to experience emotional difficulty when faced with challenge or uncertainty. Data suggested that most differences between respondents who disliked/avoided neurology and those who enjoyed neurology were due to differences in personality traits and associated affective responses, rather than intellectual difficulties.

7 Towards a model for the development of differing perspectives of neurology

Perceived difficulty has worn much of the blame for individuals' negative perspectives of neurology in previous research on neurophobia. Intellectual difficulties are commonly highlighted in investigations into neurophobia and perceptions that neurology was challenging were frequently voiced amongst my cohorts, regardless of whether they disliked/avoided or enjoyed neurology. However, in all phases of my research, there were differences in individual's affective responses when they faced difficulty. In Chapter 2, an overly simplistic model was presented, based on review of previous literature on neurophobia. Despite much of the previous literature focusing on intellectual difficulties, my data suggests that differing perspectives of neurology are due to differences in affective responses to experiences of neurology.

The preceding three chapters presented the findings from a qualitative interview study, which explored veterinarians' differing experiences of neurology, and two quantitative studies, which investigated both superficial and underlying reasons for differing perspectives of neurology amongst veterinarians and veterinary students. In this chapter, the findings of all three studies are integrated to provide a more holistic understanding of how differing perspectives of neurology develop.

The research findings, and relevant educational literature, are used to develop a model that explores how a difficult experience learning or applying neurology can lead to positive, neutral or negative perceptions of that experience, depending on context and the individual's values, personality traits, and affective reactions. Internal conflict is proposed as a pivotal factor that directs veterinarians' and veterinary students' affective reactions to their experiences learning and applying neurology. In turn, how a veterinarian or veterinary student responds to internal conflict is central to determining that individual's perspectives of neurology.

In developing the model, I discuss previous literature relating to difficulty and five aspects of the research findings that influence how an individual reacts to difficulty: (1) the influence of value; (2) perceived contributors to failure; (3) internal conflict; (4) factors affecting the ability to mitigate internal conflict; and (5) self-fulfilling perceptions.

7.1 Reactions to Difficulty

As discussed in Chapter 4, affective responses typically underpinned the cases that interviewed veterinarians chose to discuss, even when the discussion primarily centred on intellectual factors. Based on these case recollections, “easy” situations and “easy” cases were less likely to trigger intense affective responses. Therefore, experiences that influence veterinarians’ perspectives of neurology are most likely to involve triggering events in which the individual faced difficulty—either in a clinical or learning situation. Furthermore, my data suggested that personal differences in types and strengths of values influenced how the individual reacted to that difficulty and the strength of their reaction.

Experiences of difficulty learning or applying neurology were therefore chosen as the starting point for understanding how different perspectives of neurology develop. The subsequent model (Figure 7.1) was developed through exploration of how veterinarians and veterinary students may react when facing difficulty, and how their reactions might lead to them perceiving that initial triggering event as positive or negative. These factors and how they contribute to the model will be discussed further throughout this chapter.

The model includes the development of a neutral perspective. Data for these pathways is based on findings from the interviews of veterinarians (see Chapter 4).

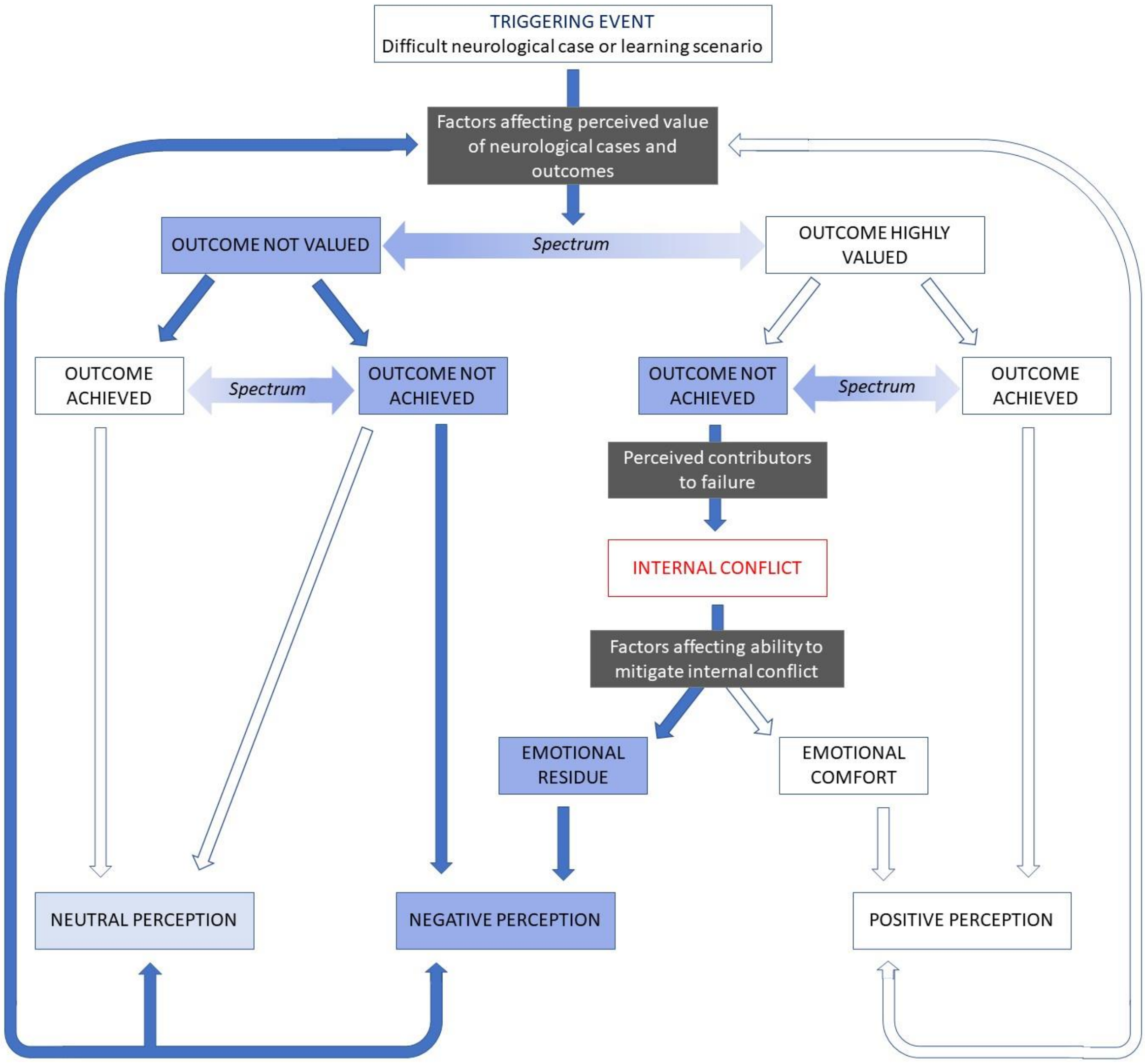

Figure 7.1 The proposed influence of internal conflict on the development of differing perspectives following an experience relating to veterinary neurology. Factors in grey boxes are mitigating, affecting an individual's subsequent reactions. Mitigating factors include personal goals and values, motivation, and personality traits such as levels of perfectionism, mindset, and tolerance of uncertainty.

7.1.1 The influence of value: factors affecting perceived value of neurological cases and learning outcomes

The likelihood of triggering an affective response in a difficult situation, and the strength of that response, appeared dependent on the value placed on achieving a positive outcome. For my interview participants there was little affective response to a negative outcome when outcome was not valued (see Chapter 4, Sections 4.3.3 Motivation and 4.3.5.1 Drive to Help Others) Additionally, the positive effects of success were dampened when there was low significance ascribed to it. In contrast, when the outcome was valued, success increased the positivity of one's perspective of the discipline. Achievement of highly valued outcomes would be expected to stimulate stronger positive affective responses, and failure to achieve highly valued outcomes would be expected to stimulate stronger negative affective responses.

Values, including relevance and interest, had the potential to drive or reduce motivation to learn or practice neurology (as discussed in Chapters 4, 5 and 6). Such values could therefore promote positive or negative perspectives of neurology. Similarly, emotional response to a course has been shown to have more effect on an individual's academic achievement in that course than their approach to learning (Trigwell et al., 2012). Essentially, if an individual is interested and wants to learn, they are more likely to succeed academically than an individual who expresses boredom, anxiety or even shame. Pekrun et al. (2002) found that boredom reduced internal motivation and led to task avoidance. However, affective responses such as anger, anxiety, and shame, had a greater effect on motivation, both decreasing internal motivation and reinforcing external motivation.

The perceived value of an outcome could also reflect a veterinarian's perception of their own ability to effect a positive outcome (see Chapter 4, Sections 4.3.3 Motivation and 4.3.5.3 Self-belief and Drive to Improve). If an individual doesn't believe they will achieve a positive outcome, no matter how much effort they expend, realisation of the expected negative outcome will trigger little affective response. Unexpected positive outcomes may also cause little affective response if success is ascribed to external factors or chance rather than good work. Therefore, for these individuals, success may have little effect on improving negative perspectives while failure either doesn't change or reinforces a negative perspective. In contrast, for an individual who believes in their ability to make a positive difference to an outcome, success reinforces these beliefs and creates a cycle of positivity.

In my data, the outcome's perceived value also depended on what the individual considered of value: for example, how highly a patient's life was valued by the owner and veterinarian, how highly an answer was valued, and how highly the owner's good opinion was valued (see Chapter 4, Sections 4.3.3 Motivation, 4.3.5.1 Drive to Help Others, and 4.3.5.6 Need for Validation; Table 5.10; and Appendix B, Table B.5, Table B.13 and Table B.14). Therefore, the perceived value of the outcome was dependent on how individuals perceived their *identity*—personal and professional values and goals—and the relevance of the triggering event in maintaining that identity. Previous literature, including within the veterinary profession, has identified variation in perspectives, depending on stage of training, veterinary sector and the individual's personality traits and past experiences (for example, Armitage-Chan and May, 2019; Armitage-Chan et al., 2016; Armitage-Chan and May, 2018; Reid et al., 2008; Wenger, 1999). This variation in perspectives means that personal perception of one's professional identity is individual, even if similar opinions are voiced by different people within the profession. Furthermore, personal perception of one's professional identity can be fluid, meaning that identity may change with time and different experiences. Overall, differences in identity mean there is no standard value for the outcome of a triggering event.

7.1.2 Perceived contributors to failure: the influence of values and traits

Perceived contributors to failure were personal to the individual. These contributors were dictated by the individual's values and traits, and by extension, their identity. How the individual viewed each experience of failure depended on their traits and values. Each individual's reaction to the contributors to failure depended on whether their values were upheld, and their identity met.

Linked to identity is an individual's expectations of themselves and what they should be able to achieve. Fear of making mistakes, particularly in high stakes situations, could heighten negative affective responses to the triggering event itself and increase perceived pressure to achieve a positive outcome.

According to Figure 2.3, failure to achieve a valued outcome would be expected to result in a worsened perspective. But veterinarians' comments indicated that failure to achieve a positive and valued clinical outcome did not necessarily result in a negative perception of the experience, provided the clinical outcome was not the only valued aspect of the experience. Multiple interviewed veterinarians commented on the satisfaction they gained from positive client interactions, and from learning and seeing self-improvement, even in situations of poor clinical outcome (Chapter 4, Sections 4.3.5.1 Drive to Help Others, 4.3.5.6 Need for Validation 4.4.1). Therefore, the clinical outcome alone did not necessarily dictate veterinarians' perspectives of the experience. Outcomes could be multifactorial, and relate to the whole of an experience or a part of it, meaning that positivity could be found in situations that might be considered failures.

Similarly, a successful outcome for the animal did not necessarily result in a positive experience for the veterinarian. Expressions of failure featured in some success stories shared by interviewed and surveyed veterinarians highlighting differences in what success meant to them. When speaking of personal definitions of success, multiple interviewed veterinarians provided either several definitions or a single definition that included multiple nuanced facets (Chapter 4, Sections 4.3.5.1 Drive to Help Others, 4.3.5.6 Need for Validation). For example, as well as the patient being sufficiently improved to have a good quality of life, the veterinarian may have required owner satisfaction, a definitive answer for the clinical signs and to feel they had personally influenced the outcome. If any of these parameters were not met the veterinarian could feel a degree of failure, with the level of failure dependent on how many parameters had not been achieved, and the perceived relative importance of those parameters.

Not only were there differences in what was perceived to constitute failure and success. Veterinarians also described differences in attribution—external *versus* internal—of the failure or success. For example, some experiences of failure were linked to external factors that prevented success. Other failures were ascribed to internal failings such as perceptions of personal inability.

7.1.2.1 External factors

External factors preventing success were commonly referenced within my data (Chapter 4, Section 4.3.4 Exposure; Table 5.7 and

Table 6.2; Appendix B, Table B.3 and Table B.4). Both interviewed and surveyed veterinarians frequently commented on financial constraints preventing advanced diagnostic investigations and treatment, difficulty accessing advanced diagnostic investigations, and the potential for neurological disease to cause severe clinical signs that could impair quality of life. For some, inability to obtain a diagnosis due to external constraints led to frustration, anxiety, and stress over uncertainty and how to proceed (see Chapter 4, Section 4.3.5.4 Tolerance of Uncertainty; Appendix B, Table B.3 and Table B.4). For others, inability to obtain a diagnosis due to external constraints triggered little affective response and was seen as an inherent part of neurology. External constraints hampering learning similarly risked emotional difficulty for some veterinary students but were better accepted by others (Table 6.11).

As well as frustration, inability to obtain a diagnosis could cause dissatisfaction, with both interviewed and surveyed veterinarians feeling unable to grow their knowledge, apply their skills or obtain closure on a case (see Chapter 4, Section 4.3.5.4 Tolerance of Uncertainty; Appendix B, Table B.3 and Table B.4). Dissatisfaction led towards negative perceptions of the experience. The effects of this dissatisfaction were exemplified by the one interviewed veterinarian who experienced a marked worsening in their perspectives of neurology after graduation (Chapter 4, Box 4.3).

External contributors to success, such as the patient improving despite the actions of the veterinarian, could also decrease satisfaction and failed to resolve negative feelings such as shame or guilt (Chapter 4, Section 4.3.5.6 Need for Validation). External contributors to success therefore did not tend to lead to positive perceptions of the experience.

7.1.2.2 Internal factors

Interviewed and surveyed veterinarians and veterinary students commonly commented on internal factors such as perceptions of inability and ability to understand neurology and neurological cases or apply their knowledge.

Most surveyed veterinary students experienced greater emotional difficulty through not meeting their personal expectations of themselves (Table 6.11) Similarly, some veterinarians accompanied perceptions of inability with expressions of strong negative affective responses, such as shame, guilt and fear (for example, Chapter 4, Box 4.2; Appendix B, Table B.3). Comments from these veterinarians suggested they felt they had failed to uphold their professional obligations to the patient or client. Some of these individuals expressed comments suggesting their personal identity and perceived self-worth were closely entwined with their professional identity. As such, failure tended to be felt at a personal, as well as professional, level.

Some interviewed veterinarians expressed perceptions of personal inability as matter-of-fact statements, seeming to accept a perceived innate inability to understand neurology (Chapter 4, Section 4.3.3 Motivation. Veterinarians who spoke of innate inability to understand neurology typically disliked/avoided neurology. Some veterinarians seemed truly unfazed by their perceived inability to understand neurology. For others, it was unclear whether deeper affective responses may be present or had previously been present. For example, multiple interviewed veterinarians who seemingly accepted their inability to understand neurology spoke of situations during their lives in which they had shown significant resilience, courage, and determination. The incongruency between these stories and how they expressed their inability to understand neurology appeared discordant. As such, adoption of an apparent disregard for inability to understand may have been a mechanism designed to protect their self-view and maintain self-worth or could represent a contextual fixed mindset.

Amongst interviewed veterinarians, internal factors such as understanding and confidence typically contributed to a positive outcome and positive perceptions of the experience. Negative perceptions associated with understanding were, however, voiced when veterinarians recounted mistakes, noting that they expected more of themselves and should have done better (for example, Chapter 4, section 4.4.3). While such situations included self-recrimination, these experiences did not seem to overly influence the veterinarian’s perspectives of neurology or their perceptions of their own understanding and ability. Instead, they were seen as reminders to continue to learn and as situations that could be avoided in future.

Because failure at a low value task was unlikely to trigger strong affective responses, veterinarians' and veterinary students' perceptions of failure in high value situations were considered more likely to sway them towards a negative perception of the overall experience. As a result, the effect of potential contributors to failure was only included on the high value outcome arm of the model (Figure 7.1).

7.1.3 Internal conflict: the reaction to failure

The strength of affective responses to failure amongst the interviewees and survey respondents primarily depended on how strongly the outcome of the failure aligned or misaligned with the individual's values and traits, and therefore, identity. Misalignment between the outcome of the experience and the individual's values and identity appeared to result in internal conflict.

For example, amongst veterinary students (Table 6.10), perceived poor retention of information seemed to primarily be associated with negative affective responses (dislikes/avoids). Veterinary students who enjoyed neurology tended to express concerns about the potential to make mistakes. Those who disliked/avoided neurology reported feeling bad about themselves and their abilities, suggesting a tendency to reflect perceived failure onto their self-view. Although it was less clear from survey data, based on interviewed veterinarians' comments about their learning experiences the degree of negativity of these affective responses was assumed to be on a spectrum. Conceivably, veterinary students who considered neurology less relevant to their career or their learning would be less concerned by perceived poor retention of information. In contrast, failing to retain information could be emotionally difficult for students who considered neurology highly relevant to their career or learning, or who judged self-worth by success, ease of academic achievement or how they were perceived by others.

Such internal conflict arose as a form of dissonance, "the feeling that one's actions are not congruent with personal goals and values" (Maddison et al., 2022, p. 403). In the context of my data, internal conflict appeared to reflect feelings of failure to achieve what the veterinarian or veterinary student believed they *should* be doing or what they believed was right to do, rather than what they wanted to do or were able to do. This meant internal conflict could occur even when the clinical or learning outcome was positive if the individual believed they had not met the criteria by which they defined success, they had not performed to the full extent of their self-expectations or if they felt they did not live up to their perceptions of the veterinary professional identity.

The affective consequences of internal conflict can be profound. According to self-determination theory, humans experience three psychological needs: relatedness, autonomy and competence (Ryan

& Deci, 2000). In other words, we need to experience positive human relationships, make decisions, and take actions that align with our personal goals and values, and experience competence in achieving one's goals (or feel that competence is within reach, with focus on personal learning and development). When any of these psychological needs are lacking, our mental well-being is impaired. As internal conflict reflects failure to meet one or more of these three psychological needs, it can negatively affect motivation and feelings of satisfaction, promote alienation, and potentially create mental distress (Ryan & Deci, 2000).

Comments made by interviewed participants who expressed emotional discomfort secondary to a negative clinical experience with a neurological case, often suggested emotions such as shame, humiliation, and guilt. These responses appeared reminiscent of the concept of moral distress, the emotional outcome that arises from situations in which an individual is unable to act in the manner that they believe to be right and must adopt an alternative action instead (Webster & Baylis, 2000). To date, the concept of moral distress has primarily been explored in relation to *ethical* dilemmas in emergency services, medical professions, and the veterinary profession (for example, Arbe Montoya et al., 2019; Hefferman and Heilig, 1999; Lentz et al., 2021; Moses et al., 2018).

7.1.3.1 Moral distress

Veterinarians I interviewed shared stories that evoked emotions such as shame, humiliation, and guilt. However, there were clear differences in how different individuals reacted to those emotions. Some individuals reflected on and embraced their failure as a way to move forwards (see Box 4.1 for an example). These individuals tended to exhibit an active response to their failure, seeking self-improvement so that they could gain closure from the experience. Other individuals seemed to reflect on their failure but struggled to see past the negative (see Box 4.2 for an example). Their stories suggested on-going self-recrimination and a lack of closure. These differences suggest that how we respond to emotionally difficult situations, such as internal conflict, could vary widely, depending on the level of threat to our values, our belief in our own abilities, and the aid we receive from those around us. How we react to the situation could lead to us overcoming the difficulty and developing strategies to aid us in the future; it could also lead to on-going self-doubt, self-recrimination, and avoidance.

Human responses to emotional difficulty and failure have been explored in many guises. In the context of my research, the themes identified, and situations discussed, appeared reminiscent of literature surrounding the concepts of moral distress, moral residue and moral comfort, the development of identity, and the influence of mindset.

Morals are the pinnacle for measurement of behaviour amongst society, dictating actions we should take. Morals are shared globally amongst diverse cultures, but may arise through many different belief systems, both spiritual and otherwise. Taylor (1989, p. 4) states:

> "Perhaps the most urgent and powerful cluster of demands that we recognise as moral concern [is] the respect for life, integrity, and well-being, even flourishing, of others. These are the ones we infringe on when we kill or maim others, steal their property, strike fear into them and rob them of peace, or even refrain from helping them when they are in distress."

While Taylor's "demands" may be considered moral in nature, as veterinarians these demands are typically central to our professional identity, and society's expectations of us. Although veterinarians' professional identities vary, what is common to identified versions of veterinary professional identity is the respect for life, integrity, and well-being of others, whether animal or human (Armitage-Chan et al., 2016). Such tenets are also expected of us by veterinary clients and our colleagues (Gordon et al., 2021; Hughes et al., 2018). Therefore, moral concepts make a considerable contribution to the values veterinarians uphold when they identify as a veterinarian.

Inability to act as we believe right leads to self-criticism and self-blame, alienation from oneself and other negative effects on self-view (Kelly, 1998). When the negative emotional effects of moral distress remain unresolved, they can lead to persistent affective discomfort known as moral residue. Failing to uphold one's morals can be emotionally catastrophic, as morals are a measure against which we gauge our self-worth (Taylor, 1989). Although referring to deep emotions such as falling in love, Miller (1992) noted that "when the very center of the self is deeply affected … one's whole way of thinking about the world, as well as one's whole way of feeling it, is profoundly and permanently altered." In a similar way, moral residue can cause persistent and negative effects on one's well-being, relationships with others, and ability to cope with difficult situations.

In opposition to moral residue, is moral comfort. Moral comfort is defined as a "feeling of ease about a decision related to ethical problems" (Corley & Minick, 2002). Moral comfort can develop from situations of moral distress, provided the individual is able to develop strategies that address the cause of their distress. Taking action to address moral distress can, however, be difficult. Attempts to resolve moral distress may be personally confronting, require organisational change, or discussion of potentially sensitive topics with others (Corley, 2002; Corley & Minick, 2002).

7.1.3.2 Towards a concept of emotional distress

Early evaluation of the concept of moral distress focused on external constraints preventing an individual from acting in the way they believe to be right (Jameton, 1984). However, I would argue the internal conflict created through disparity between a desire to act and a lack of confidence, knowledge or clinical approach could result in similar emotional disturbances to that of moral conflict caused by external impediments. Webster and Baylis (2000) touched on this in their definition of moral distress, suggesting that personal failings and errors in judgement contribute to moral distress as much as factors beyond the individual's control.

It could be argued that the emotional disturbance generated by feeling externally forced to act in a manner contrary to one's beliefs may produce greater distress than perceived poor personal performance. However, I would argue that the perception of being personally responsible for failing in one's duty to both the patient and client may also result in marked emotional disturbance. Potentially, the emotional discomfort may even be greater when the limiting factor is internal, as one cannot blame perceived suboptimal actions on factors beyond one's control ("it would have turned out differently if I was able to act as I wanted"). Instead, the lack of appropriate action rests on the shoulders of the individual, potentially increasing feelings such as guilt, regret, and self-recrimination.

A shift in understanding of professional priorities and goals occurs as new graduates encounter the reality of the workplace, resulting in challenge to, and reshaping of, the individual's professional identity (Armitage-Chan, 2020; Nyström, 2009; Pratt et al., 2006). The process of forming an identity can be associated with self-questioning and confusion. It is possible that the concomitant exploration of a new understanding of one's identity may increase the emotional effect of situations in which identity conflict and moral distress are encountered. New graduate nurses have been reported to experience moral distress through the belief that they were failing to meet their moral convictions (Kelly, 1998), and there is increased risk of a recent veterinary graduate leaving their first job following situations of feeling out of their depth or emotionally unsupported (Gates et al., 2020). New and recent graduate experiences featured heavily in anecdotes of difficult or emotionally distressing cases recounted by veterinarians I interviewed. It is possible that increased stress levels at this time of professional development may have exacerbated feelings of internal conflict associated with perceived failures as a new or recent graduate.

When considering the potential for internal conflict, veterinarians' desire to help injured or ill animals should not be overlooked. The desire to help injured or ill animals has been shown to be the primary motivator for pursuing a veterinary career in approximately one-third of surveyed veterinary students, and in the top three motivators for approximately 70% (Verrinder & Phillips, 2014). Furthermore, it has been shown that the combination of moral stressor events and perfectionism can increase vulnerability to negative effects on psychological well-being (Crane et al., 2015). Veterinarians are known to be prone to traits of perfectionism (Zenner et al., 2005), strong determination to become a veterinarian and high personal expectations (Cardwell & Lewis, 2017; O'Connor, 2019; Zenner et al., 2005), and to suffer emotional effects from client expectations (Spitznagel et al., 2019). These characteristics were also reflected amongst the interviewees and survey respondents in the current research. Within my data, veterinarians who disliked/avoided neurology had significantly lower tolerance of uncertainty and a more fixed mindset than veterinarians who enjoyed neurology. Veterinary students who disliked/avoided neurology had significantly lower tolerance of uncertainty and higher scores in the maladaptive perfectionism scale Concerns over Mistakes and Doubts about Actions. Such traits likely exacerbate emotional difficulties associated with perceived failure. The internal and external pressures identified both in my data and in previous literature could contribute to the strength of emotional conflict and feelings of failure when veterinarians and veterinary students are unable to act in a way they consider paramount to being a veterinarian, thereby creating emotional distress.

Veterinarians' priorities not only include our patients but also our clients. Over one-third of veterinarians and half of veterinary students I surveyed considered meeting the needs of the owner to be in their top three clinical priorities (Appendix B, Table B.5 and Table B.14). Unfortunately, this can cause veterinarians internal conflict when patient and owner needs do not align. In medical literature, some evaluation of *role* conflict has been reported. Role conflict was defined by Katz and Kahn (1966) as "a simultaneous occurrence of two (or more) sets of pressures such that compliance with one would make more difficult compliance with the other" (p.184). According to these authors, a role is "a set of activities or expected behaviors" (p. 173) associated with an individual in a particular position within an organisation. These expectations, which can include not only an individual's abilities, but also their thoughts, beliefs, and the kind of person they should be, are not restricted to the job description but are influenced by all stakeholders. As such, there is potential for considerable differences in how that role, and its inherent requirements, are perceived by different individuals. Role conflict could result from stakeholder pressure on an individual to conform to expectations not shared by that individual.

Veterinary medicine is a unique profession as the interests of the patient and client may be at odds, with financial limitations adding a third potential pressure that may affect the veterinarian's ability to successfully undertake the professional role they believe appropriate. While studies have reported emotional resilience of individuals with a well-developed identity (Kroger & Marcia, 2011), there has been less exploration of how individuals with clear and firm views of their professional identity might be affected by inability to meet the requirements of that identity. Similarly, in a profession such as veterinary medicine in which black and white views may be difficult to uphold, it is unclear how one's strength of commitment to one's beliefs will affect them mentally if those beliefs are frequently compromised or unmet.

Role conflict has been described in terms of external and internal pressures, and in relation to compartmentalised roles, such as professional and personal priorities. This separation does not consider how an individual might react to conflict when their professional and personal identities are closely interwoven, and full dissociation is not possible. In interviews with veterinarians and veterinary nurses, Page-Jones and Abbey (2015) highlighted how integral being a veterinarian was to some individuals' perception of themselves. Anecdotally, this finding was echoed in the comments of a friend who struggled when considering leaving clinical practice: "being a vet is most of my identity so who am I without it?" (personal communication). Such interweaving of identities could represent a tendency to be drawn to characteristics of a profession that are akin to our personality and how we view ourselves. Alternatively, as suggested by Katz and Kahn (1966), the melding of identities might result from the behaviours required by our professional role affecting our personality, essentially causing us to "become what we do" (p.188). Whatever the cause, this melding of identities could mean that, for some individuals, failure to meet perceived requirements of their professional identity translates into questioning their personal identity. For these people, perceived professional failure might be equated to failure as a person and professional conflict could challenge self-identity.

Internal conflict, experienced from perceived failure to achieve a highly valued outcome, could explain negative affective responses shared by interviewed and surveyed veterinarians and veterinary students in my research. The strength of the negative affective responses was in turn dependent on the degree of internal conflict the individual experienced and could range from frustration to dissatisfaction to severe self-recrimination and loss of self-worth. As such, internal conflict appeared one of the pivotal factors in determining how veterinarians and veterinary students perceived their experiences of neurology. Equally important was how the individual reacted to that internal conflict.

The affective responses underpinning my findings, and the potential for such responses to persist or be resolved, are similar to those described in the literature on moral distress. However, there are important distinctions between previous literature on moral distress and application of the concept of moral distress to my data. Namely, to date, the concept of moral distress has primarily been explored in relation to ethical dilemmas and being prevented to act by external constraints. In contrast, my application of the concept relates to inability to act due to internal constraints. I therefore propose the term emotional distress to describe the affective results of internal conflict associated with being unable to act in a way an individual believes they should, due to internal factors such as understanding and confidence. Further borrowing from the literature on moral distress, I term the persistence of such distress emotional residue, and the resolution of the distress emotional comfort.

7.1.4 Factors affecting the ability to mitigate internal conflict

Amongst the veterinarians I interviewed, it seemed some individuals were either unaware of, or unwilling to take, steps that could lead to emotional comfort after perceived failure to achieve a highly valued outcome. Some of these individuals thought they had taken appropriate steps, but their stories suggested little or no emotional comfort had been achieved (Chapter 4, Section 4.3.5.3 Self-belief and Drive to Improve). For example, all veterinarians who discussed making mistakes also spoke of learning from those mistakes. But for some veterinarians, learning from their mistakes seemed to comprise simply refraining from similar actions in future cases; their way of learning from mistakes seemed passive and a form of avoidance. In contrast, other veterinarians sought to learn from their mistakes by seeking greater understanding, help from more experienced colleagues, and to improve their skills. In these situations, learning from mistakes seemed not only a form of active prevention but also allowed the individual the opportunity to reflect on, rationalise and understand their perceived failure.

Reasons for interviewed veterinarians' differences in willingness to seek emotional comfort and differences in strategy to achieve emotional comfort were not clear. Review of the interview and survey data suggested several explanations based on individuals' values. Firstly, effort expended to address the failure would depend on the individual's motivation to prevent similar failures in future. In part, this will depend on the relative value of the outcome. Alternatively, as strategies to gain emotional comfort can involve the need to seek help from others, individuals who value the appearance of competence and find it difficult to show weakness could be reluctant to acknowledge their perceived failure to others. Not seeking help from others could be a subconscious effort to protect self-worth. Next, individuals with a fixed mindset or those who believe they have no control over such situations may simply accept the failure as a consequence of their inability to effect a positive outcome, not recognising that there may be ways to gain emotional comfort. Such acceptance of failure contrasted with other individuals whose comments reflected the belief that failure was contextual and not an indication of their true ability (Figure 7.2). And finally, individuals who expressed sentiments suggestive of fear of failure or maladaptive perfectionism may have avoided efforts to address the cause of their internal conflict. Not only could reflection on failure be confronting, but it may not be easy to understand the theory underlying why the failure occurred. Already dealing with the emotional fallout of one failure, these individuals may have been unwilling to risk failing again.

As discussed above, moral residue risks considerable emotional disturbance that can be uncomfortable and confronting for the individual. Emotional residue might therefore predispose an individual towards avoidance of similar situations. Although discussing mindset, Carol Dweck and colleagues (for example, Diener and Dweck, 1978, 1980; Elliott and Dweck, 1988) found that individuals who prioritise avoiding negative judgements of their ability are more likely to choose tasks they think they can succeed in or are so difficult that failure can be explained without reflecting poorly on themselves. These individuals seek avoidance of tasks that threaten to result in negative judgement of self. Emotional residue is likely to result in a similar desire to avoid situations that risk feelings of inadequacy.

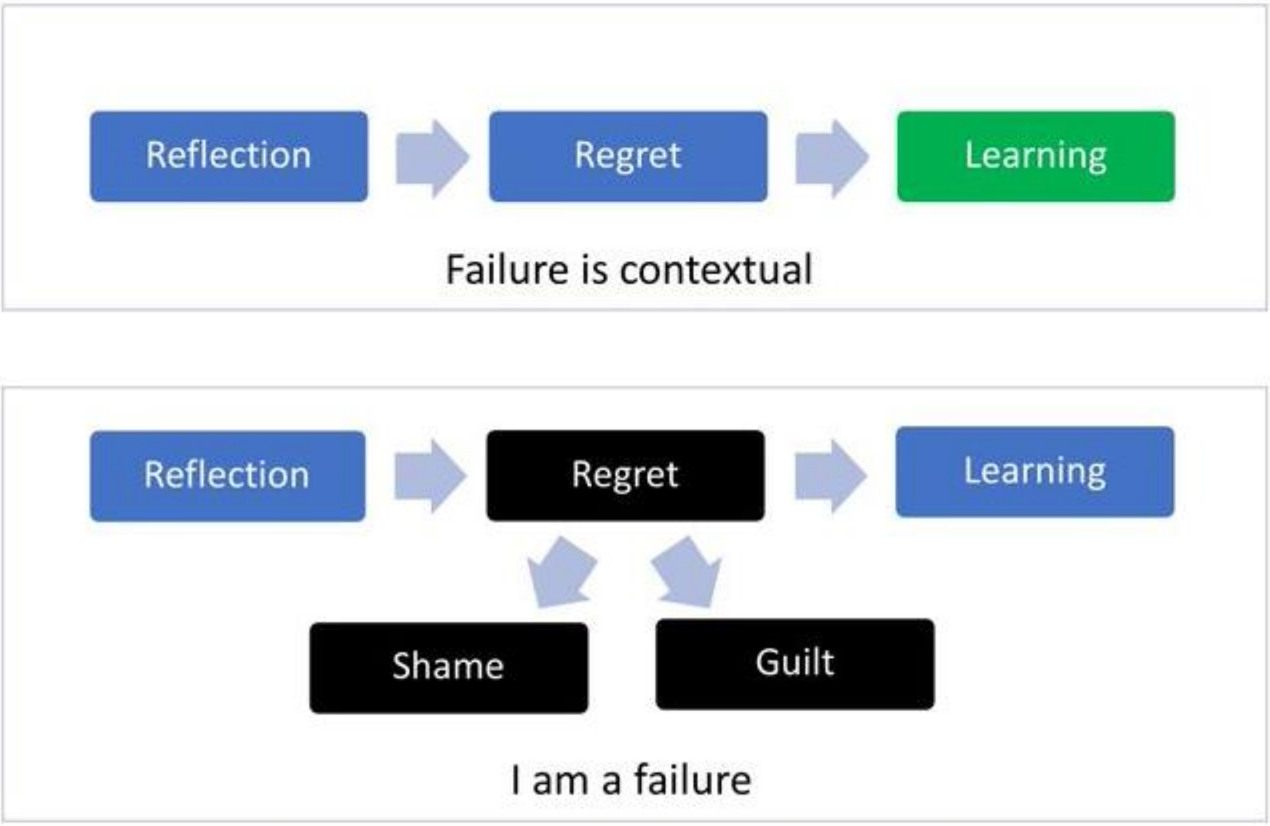

Figure 7.2 Depiction of the process of reflection, regret, and learning from one's mistakes. In the top box, the individual focuses on the positive – that they were able to learn from their mistakes. Failure becomes contextual and can be overcome. In the bottom box the individual focuses on their regret, leading to shame and guilt. Self-recrimination directs the failure inwards and can become a personal reflection of the individual's lack of ability. This can be harder to overcome and may be a persistent cause of distress or other negative emotions.

7.1.5 Effects on future experiences: how perceptions become self-fulfilling

Amongst veterinarians I interviewed, those with negative perspectives of neurology described how they expect difficulty when dealing with neurology cases. For example, “I do cringe when I see something that looks neuro” (Grace), and “urgh, it's neuro, it's going to be hard” (Sienna). These expectations of difficulty were based on negative perceptions of previous experiences. In contrast, veterinarians with positive perceptions of previous experiences tended to approach future cases without overt bias. Essentially, affective cycles were created in which perceptions of experiences, negative, neutral, or positive, influenced the individual’s perceptions of future experiences. A negative affective cycle often resulted in the development of affective disturbances before the veterinarian had even seen the case, potentially amplifying any negative affective responses to subsequent perceived failure. Similar affective disturbances were suggested in veterinary students’ reports of factors that caused them emotional difficulty. Almost half of veterinary students who disliked/avoided neurology experienced higher emotional difficulty when preparing for a test or examination, while approximately one-tenth of students who enjoyed neurology made the same claim (Table 6.11).

Moral distress can develop in response to single large threats to morals, or by smaller but frequent threats that build distress over time (Corley, 1995). It is possible that, amongst my cohorts, negative affective cycles could contribute to increased levels of internal conflict and emotional distress. Gradual increases in internal conflict could potentially hinder the development of strategies to address the conflict, as the individual may not have even been aware how their emotions were changing.

7.2 Our Responses to Threatened Values

The model created in this chapter (Figure 7.1) provides explanations for why some veterinarians and veterinary students develop positive attitudes towards neurology and positive perspectives of difficult events, and why others develop negative attitudes and perspectives. Because this model is based on affective responses to difficulty, it could apply to any difficult subject or case the veterinarian or veterinary student encounters. Therefore, although the model was developed from data relating to perspectives of neurology, it may be more broadly applicable.

According to my model, pivotal to the development of veterinarians’ and veterinary students’ perspectives of a difficult case or learning situation were whether the event threatened their values and identity, and how the individual reacted to that threat. In other words, whether the individual was able to lessen or resolve their emotional distress and achieve emotional comfort from failure, or whether that distress persisted to create emotional residue. As the model shows, positive or negative cycles of emotion can develop, affecting the individual’s future response to difficult situations.

The ethical dilemmas associated with moral distress amongst medical professionals, first responders and veterinarians include perceived futile treatment, failing to prevent injury, and euthanasia of healthy animals (for example, Arbe Montoya et al., 2019; Crane et al., 2015; Hefferman and Heilig, 1999; Lentz et al., 2021; Moses et al., 2018; Verrinder and Phillips, 2014). These situations are often emotionally charged, high stakes, and involve competing interests, potentially forcing an individual to act in a manner they fundamentally and morally disagree with. For nurses and first responders, factors that contribute to these ethical dilemmas include feelings of powerlessness and conflict regarding decisions made, high levels of responsibility, lack of authority, and high intensity—regarding emotional expectations and investment, or intensive care—medical or social environments (Hefferman & Heilig, 1999; Lentz et al., 2021). These factors were also described by veterinarians I interviewed, whether the issue was purely ethical or not. Emotionally difficult recollections included feeling helpless when unable to perform investigations or appropriate treatment, lack of support despite the need to make high-stakes decisions, dealing with the aftermath of situations not of their choosing, and feeling responsible for being able to or not being able to sway others' decisions.

As noted above, previous evaluation of moral distress has primarily focused on external constraints. In nursing literature, factors identified as potential contributors to these ethical dilemmas are similar to issues faced by veterinarians, such as limitations in resources, and financial constraints (Corley, 2002; Huffman & Rittenmeyer, 2012). But moral distress is not only experienced in situations of external lack of control. While autonomy to make choices may be protective for some individuals, those with autonomy can also experience moral distress (Corley, 2002). The likelihood is that the same applies to emotional distress.

Autonomy may be limited by internal constraints, such as a lack of confidence, appropriate knowledge and clinical approach. These internal constraints may prevent an individual from acting, no matter how much they desire to do so. As previously discussed, greater intolerance of uncertainty was evident amongst individuals who disliked/avoided neurology in all three studies in my research. Being unsure of how to act, or whether an approach is appropriate, could have contributed to the experience of emotional distress amongst the interview and survey participants. Distress specifically associated with uncertainty (Freeston et al., 2020) might also exacerbate the situation, with emotions such as frustration, anxiety, panic, regret and shame adding to the maelstrom of negative affective responses.

The previously noted propensity for perfectionism, amongst veterinary professionals in general (Holden, 2020) and participants in my research, has the potential to exacerbate emotional distress. Armitage-Chan et al. (2016) referred to the perception of a veterinarian as an "infallible expert", a perception that likely increases pressure on veterinarians to conform to a realistically unattainable idealisation of what a veterinarian is. Such an identity is impossible to maintain, as it requires perfection, and is therefore expected to promote frequent experiences of emotional distress.

Identity is a complex construct, informed by our values—including personal principles and moral views—and the way(s) that these values direct our decisions and actions (Armitage-Chan & May, 2018; Taylor, 1989). Although personal and individual, our sense of identity can be shaped by our environment, our culture, and those around us. Threats to our identity mean threats to our perceptions of who we are and how we fit into the world around us. Like situations of moral distress, this can cause marked emotional distress:

> "The recognition that my life is turned away from [what I value], or can never approach it, would be devastating and insufferable. It threatens to plunge me into a despair at my unworthiness which strikes at the very roots of my being as a person."
>
> (Taylor, 1989, pp. 62-63)

Conversely, and like adherence to our morals, when we are secure in our identity, we can feel whole. As such, our sense of identity can be essential to our well-being.

The complexity of identity means that there are multiple ways in which nuances of identity might have contributed to the differences in how interviewed and surveyed veterinarians and veterinary students reacted to difficulty. Possible reasons for different reactions to perceived failure included the relative strength of, and commitment to, an individual's values, the fit of the professional identity, the degree of separation between professional and personal identities, and the flexibility of the individual's identity.

Amongst my data there appeared to be differences in the relative strengths of an individuals' values. For example, although some veterinarians highly prized a positive patient outcome, more important was the belief that they had done all they could and afforded the patient and client respect. Therefore, the strength of commitment to each value seemed to influence how the individual reacted when that value was threatened. Threats to values the individual was less committed to were better tolerated, potentially because these values contributed less to the individual's identity or did not completely fit that identity. As Grotevant (1987) argued, identity formation is not only dependent on committing to an identity but how strong that commitment is.

There are multiple factors that may affect the level of one's commitment to one's identity. Some influences are external and involve the individual conforming to what they believe is expected of them, rather than their own interests and values (Luyckx et al., 2009). These influences may contribute to a poorly fitting identity that the individual struggles to maintain. Other influences are internal and are driven by true reflections of self. As Kroger and Marcia (2011) discussed, the *how, when,* and *why* in which an individual develops their identity is as important to that person's response to different situations as the identity on which they have settled. The process of identity development will dictate how well that identity fits the true values of the individual. Those whose identities best reflect their internal priorities are considered to perform better under stressful situations (ibid.). In contrast, Luyckx et al. (2009) noted individuals who feel pressured into accepting an identity that does not fit their own values or interests are more likely to experience self-doubt.

How well professional identity fits an individual might explain some of the differences in the level of, and response to, internal conflict and emotional distress that veterinarians and veterinary students experienced after perceived failure. If self-doubt is unresolved, an individual may continue to question themselves, resulting in erosion of confidence. Repeated challenges associated with the same discipline might also increase that self-doubt, or focus that self-doubt to specific circumstances, such as certain cases within that discipline. Jozefowicz (1994) spoke of "paralysis in action" in his seminal description of neurophobia in medical students and medical professionals. Interestingly, Luyckx et al. (2009) also noted that the ability to determine an appropriate course of action in a complex situation is impaired when a sense of identity is lacking. As a result, the individual might find themselves unable to act. My data suggested that both veterinarians and veterinary students struggled when they lacked an approach to cases and learning. It is possible that inability to act added to emotional stress and anxiety, with additional concerns over external consequences of one's inaction, including social and organisational backlash (Lentz et al., 2021), and fear of litigation (Nash et al., 2004). It is not inconceivable that inability to act could create a reinforcing cycle of avoidance due to fear of negative consequences, affecting one's confidence and ability to act, particularly in high stake situations.

Poorly fitting professional identities might also have contributed to the tendency for some of the veterinarians I interviewed to engage in higher levels of self-recrimination when discussing perceived professional failures. An alternative possibility is that veterinarians who expressed greater self-recrimination when discussing perceived professional failure had little separation between their professional and personal identities. Although literature tends to separate professional and personal identities, these are closely interwoven for some individuals (Page-Jones & Abbey, 2015). When professional and personal identities are entwined, perceived failure as a veterinarian equates to failure as a person. There appears to have been little exploration of how an individual might react to conflict when their professional and personal identities are closely interwoven; this could be a topic for further research.

The strength of affective responses to case outcome might also be influenced by how early veterinarians commit to their profession. It has been shown that veterinary students who exhibit higher emotional investment in cases are often those who view veterinary medicine as a vocation or have a lifelong ambition to become a veterinarian (Roder & May, 2017). When there is higher emotional investment, it would be expected that stronger negative affective responses would occur in response to perceived failure.

Commitment to the veterinary profession at an early age is common amongst veterinary professionals (Page-Jones & Abbey, 2015), and was mentioned by many of the veterinarians I interviewed. Such lifelong commitment could contribute to these veterinarians having difficulty visualising themselves in any other profession, reducing flexibility and adaptability in identity formation (Page-Jones & Abbey, 2015). Reduced adaptability in identity development might exacerbate difficulties encountered when an identity is primarily based on ideals that poorly reflect the reality of clinical practice. In these cases, threats to identity may be frequent once the individual enters clinical practice as the individual finds it harder to reconcile their idealised identity with the internal and external constraints of reality. While not explored amongst my data, further investigations might evaluate whether there are differences in clinical priorities, tolerance of uncertainty, and perfectionism levels and types between veterinarians who commit to the profession at different ages.

The ability to resolve emotional distress created by internal conflict appeared of vital importance to how my cohorts ultimately perceived their experience of failure or difficulty. Previous literature has suggested several ways that moral distress can lead to improved comfort or persistent negative emotions. These suggestions may also explain some of my findings.

In their discussion of moral residue, Webster and Baylis (2000) suggested that positive personal growth can occur when the individual better understands what led to the experience of moral distress. Understanding this allows individuals to prevent similar experiences in the future, akin to the comments made by veterinarians I interviewed regarding learning from the experience. Understanding what led to moral distress can also allow one to develop contextual tolerance of inciting situations without lowering one's values ("I don't personally agree with the decision or action taken, but I accept that I must live with it" (Webster & Baylis, 2000, p. 225). In my data, contextual tolerance amongst interviewed veterinarians and survey respondents seemed to manifest through, for example, finding ways to manage clinical constraints and cope with uncertainty. While I would expect these coping methods to bring some degree of emotional comfort to veterinarians and veterinary students, how much comfort would depend on the extent to which the individual engaged in the reflection process. Although many veterinarians I interviewed commented on learning from their mistakes, in some cases this learning appeared superficial and passive, and did not address persistent negative affective responses to the inciting experience. In contrast, veterinarians who acknowledged their failures and could speak about them positively seemed to have not only reflected but taken action to address their perceived failings.

More consistent with my findings is the suggestion that moral distress can galvanise some individuals' commitment to their values. Huffman and Rittenmeyer (2012) found that experiencing moral distress can increase nurses' sense of patient advocacy. Furthermore, it was noted that some nurses determined that they were unable to work in an environment that was in opposition to their values. According to my argument, if emotional distress is created by internal constraints, the environment opposing an individual's values is created by their own limitations. This is supported by the ways some veterinarians I interviewed sought to address their internal conflict through improving their understanding, approach, and skillset. In essence, personal growth allowed these veterinarians to better align their clinical processes to their values, thereby improving their internal working environment.

When it is not resolved, moral distress can lead to job dissatisfaction, disconnection from one's values, and detrimental effects on patient care (Benner et al., 2009; Lentz et al., 2021; Rubin, 2009; Wilkinson, 1987). Webster and Baylis (2000) suggested these negative effects may result from prioritising self-protection over the threatened values. Methods of self-protection included denial that incoherence between beliefs and actions existed, trivialisation of that incoherence, or simply accepting that incoherence without reflection (Webster & Baylis, 2000). These responses to moral residue can promote compartmentalisation of one's identity and disassociation from the experience, attempts to convince oneself that the incoherence is unimportant, or even force a change in values that is motivated by fear of failure rather than belief the value should change. These actions may desensitise the individual to similar situations in which their values are compromised and enable acceptance of progressively larger threats to their values (Webster & Baylis, 2000). Similar effects would be expected to develop secondary to emotional residue. In the context of my research, such negative and self-protective behaviour might be reflected in veterinarians' and veterinary students' perspectives that there is little that can be done for neurological cases or that these cases are inherently too difficult to understand. Such perspectives could lead to reduced effort when dealing with neurological cases or learning neurology, with the perception that high expenditure of effort is futile. A form of avoidance could develop, to the potential detriment of the veterinarian's emotional growth and well-being, and patient and client care.

Strategies promoting self-protection when faced with moral and emotional distress may be common amongst veterinarians. Moses et al. (2018) noted the tendency for surveyed veterinarians to accept internal conflict as an inherent part of veterinary practice, perhaps failing to recognise why the situations cause distress and that steps could be taken to mitigate its effects. Batchelor et al. (2015) raised similar concerns regarding the lower-than-expected level of moral reasoning in some veterinarians when faced with an ethical dilemma. It was surmised that acceptance of others' decisions and perceived futility of challenging others' actions could lead to reliance on simplistic moral reasoning as a coping mechanism. In veterinary practice, examples in which challenging others' decisions are perceived as futile could include when finances dictate treatment, or euthanasia dilemmas in which the right of the client is upheld over patient interests. Such situations appear to be common, with financial constraints considered one of the two most common external constraints veterinarians face (McKenzie, 2014). These findings therefore raise interesting questions: does frequent exposure to internal conflict sustain and build emotional residue amongst veterinarians, or do we become desensitised and shift our value goalposts? If we do not recognise the source of our discomfort, how do we react when faced with further threat to our values? Further research may provide the answers to these questions both in relation to veterinarians' and veterinary students' perspectives of neurology and in relation to other sources of internal conflict in veterinary practice and undergraduate veterinary study.

How we react to internal conflict may be influenced by not only our background (social, cultural, spiritual, and previous experiences) but also by our personality. In my research, scores in perfectionism subscales linked to maladaptive perfectionism tended to be higher amongst veterinarians and veterinary students who disliked/avoided neurology. Additionally, scores in perfectionism subscales associated with adaptive perfectionism tended to be higher amongst those who enjoyed neurology. Perfectionism has been suggested to increase the potential for emotional distress in situations veterinarians consider morally challenging; individuals with greater perfectionism scores ascribed higher significance to situations in which they faced moral challenge (Crane et al., 2015). Although there was no differentiation between the types of perfectionism in the study by Crane et al. (2015), one might presume that moral challenge and challenges to values and identity may be more confronting amongst those with maladaptive perfectionism as this is primarily driven by fear of failure rather than striving to improve (Lo & Abbott, 2013). Maladaptive perfectionists might therefore feel less autonomous than adaptive perfectionists, and more constrained in both their actions and ability to address their actions. Internal conflict created by failure to achieve a valued outcome might also be more emotionally difficult for maladaptive perfectionists than adaptive perfectionists, as failure reinforces feelings of inferiority and is the realisation of the situation they strive to avoid.

Although it was not evaluated in my study, willingness to actively pursue strategies to reduce internal conflict and gain emotional comfort might also have been influenced by impostor phenomenon. Impostor phenomenon, feelings of self-doubt and being underqualified that lead to fear of being discovered as a “fraud”, has been suggested to affect up to 68% of veterinary students and veterinarians, with a higher frequency amongst newer graduates (Appleby et al., 2020; Kogan et al., 2020). Idealisation of professional identity might also contribute to these feelings of inadequacy, with the development of an unattainable construct of what a veterinarian is or can achieve (Armitage-Chan, 2020).

Like maladaptive perfectionists, veterinarians and veterinary students suffering from impostor phenomenon would be expected to experience emotional difficulty when encountering perceived failure, with exacerbation of their pre-existing feelings of self-doubt and being underqualified. Furthermore, these individuals may find it difficult to embrace some strategies that could improve their learning from that experience of failure. Most of the veterinarians I interviewed who discussed how they reached emotional comfort after internal conflict spoke of seeking help and support from colleagues and specialists. Such strategies involve admission of failure and areas of weakness to peers and those held in high regard. As individuals with impostor phenomenon highly value the regard of others and wish to maintain the appearance of capability, publicly admitting failure and weakness also threaten identity and may cause further emotional distress. Attempting to address their internal conflict might risk, or be perceived to risk, further failure, a situation that may be untenable for those with impostor phenomenon or maladaptive perfectionism. Therefore, veterinarians and veterinary students with impostor phenomenon may choose not to pursue strategies that could reduce the negative affective responses associated with internal conflict.

7.3 Further Considerations

The models in Figure 7.1 and Figure 7.2 are based on my interpretation of data. Some of this data was obtained from surveys, which prevented clarification of answers. Interpretations of interview data were undertaken after the interviews had concluded, preventing further exploration of my interpretations. Therefore, other interpretations of the data are possible and may not be consistent with these models. Furthermore, I may have missed uncovering valuable information that could have strengthened or weakened the arguments It is also possible that my own experiences as a veterinarian and a learner may have introduced bias to my interpretations. However, those same experiences afforded me insight to help make sense of my colleagues comments and affective responses, as I have also experienced the many impediments to case management that can affect outcome and witnessed colleagues' reactions in response to failure.

The pathways that lead to a neutral perspective were based on interpretation of interview data rather than analysis of the responses of survey participants who identified as indifferent to neurology. It is likely that deeper exploration of the perspectives of veterinarians and veterinary students with indifferent attitudes towards neurology would identify additional factors that influence the development of a neutral perspective. However, given the model is a simplified representation of the processes that influence attitude development, and the premise of these pathways is supported by the interview data, the model provides logical and justified explanations for the development of a neutral perspective of an experience.

These models are simple representations of factors that could affect veterinarians' and veterinary students' perspectives of and attitudes towards neurology. Understanding all the nuances, subconscious, and unverbalised influences on the development of one's perception of an event would require considerably more data. Furthermore, it is not possible to create a "one-size-fits-all" model, as different individuals will experience varying degrees of reaction to the same event even if they have similar values and personality traits. However, these models do provide a starting point in trying to understand what influences the development of different perceptions of a difficult event.

Whether or not an experience could be considered a triggering event depends to some extent on the context in which it is viewed. The ability to emotionally rationalise a situation that could potentially cause moral conflict was evident in Peterson et al.'s (2022) study of veterinarians' reactions to medical futility. Although perceived futile treatment of patients would typically be considered inappropriate by many veterinarians, potential benefits to owners, such as allowing time to reach the clinic to say goodbye to their pet, appeared to temper many veterinarians' perception of the situation. In fact, a quarter of those surveyed indicated they might even consider such futile treatment for their own pet in certain circumstances. Context and strength of values can therefore influence our responses to situations in which our identity is challenged and may even prompt deviation from expected emotional outcomes when faced with identity threat. This also means that the effect of context potentially limits any generalisations or models of behaviour, including those I have made.

The model outlined in this chapter was developed through evaluations of participants' recollections of triggering events. To better understand whether the model is representative of how differing perspectives of a triggering event develop, these triggering events should be explored both soon after they occur and re-evaluated at a later date. Exploration of the event soon after it occurs would reduce recall-associated inaccuracies, while re-evaluation after a period of months would increase understanding of the long-term effects of the experience, and explore reasons why perspectives of the event may have changed over time. Such research would also enable greater exploration of factors that influence the development of a neutral perspective, and has the potential to identify factors that modulate the strength of an individual's reaction to triggering events.

7.4 Conclusion

Veterinarians' and veterinary students' perspectives of neurology were influenced by their perceptions of, and reactions to, difficult experiences they encountered when dealing with neurological cases and learning neurology. The level of perceived difficulty depended on the outcome of the event, the value of the outcome, why the veterinarian believed they had failed or succeeded, the strength of internal conflict that resulted from failure, and whether the individual was able or willing to address the underlying cause of that conflict. Although veterinarians and veterinary students described similar contributors to these difficult experiences, some individuals were able to resolve their initial negative affective responses and gain a more positive perspective, while other individuals expressed persistent negative emotions. The data suggests that how the individual reacts to a difficult experience depends on the strength of internal conflict that arises from the experience and their willingness and ability to actively engage in strategies to resolve that conflict.

8 Discussion and Conclusions

My research sought to explore deeper reasons for individuals' perspectives about their experiences of neurology and neurological cases, to aid our understanding of why differing perspectives of neurology develop. Previous literature on neurophobia focused on perceived difficulty as a leading contributor to the development of neurophobia, or as the operationalised definition of neurophobia, and the quantitative nature of many of these studies limited our ability to understand why difficulties arose and what effect they had on the individual. The previous chapters presented the findings of my research and a theoretical model for how different factors may contribute to veterinarians' and veterinary students' perspectives of neurology.

In this chapter, the research questions are addressed through summary of the research findings and the conclusions reached through integration of the findings from all three research phases. The strengths and limitations of the research as a whole are discussed, and the implications of the findings and how they may shape future research are explored.

8.1 Summary of the Research Findings

This research comprised a mixed method approach, utilising qualitative interviews and two quantitative surveys to explore veterinarians' and veterinary students' experiences and perspectives of neurology. The findings of each of these three studies were then integrated to consider not only the reasons underlying the development of differing perspectives of neurology, with a focus on positive and negative perspectives, but also factors that influenced how and why perspectives might change. The research was guided by four research questions.

Firstly, what are veterinarians' perspectives of neurology? The subject of neurology tended to be viewed more positively amongst the surveyed veterinary students than the surveyed veterinarians. Not only did almost half of all surveyed veterinarians dislike/avoid neurology, but most veterinarians believed neurology was disliked by the general veterinary profession. Interviewed veterinarians' descriptions of their undergraduate experiences of neurology often expressed confusion, with high levels of detail, limited connections between theory and application, and inability to recall what they had learnt. Such comments were reflected in responses from surveyed veterinary students, with neurology often considered interesting and challenging, but overwhelming and difficult to apply and retain.

Secondly, this research explored what influences the development of veterinarians' perspectives of neurology. Most veterinarians reported their undergraduate experiences of neurology were less positive than their experiences after graduation. Little exposure to neurological cases after graduation was significantly associated with a negative perspective of neurology, mirroring students' comments that insufficient repetition of neurology theory created difficulties retaining and understanding neurology. Regardless of whether their perspectives of neurology were positive or negative, veterinarians and veterinary students reported intellectual and logistical difficulties when learning neurology and managing neurological cases. It was the type and strength of their affective responses to each difficulty, and how the individual dealt with those affective responses, that appeared to differentiate how the experience influenced the individual's perspective of neurology. The reasons for differing affective responses were complex, contextual, and multifaceted; each affective response was nuanced and personal to the individual. However, from a holistic perspective, affective responses appear to be dependent on: 1) the value ascribed to the outcome of the experience; 2) professional and personal identity, and the level of separation between these identities; 3) personality traits such as mindset, tolerance of uncertainty, and level of perfectionism; and 4) whether the individual is able to resolve internal conflict and emotional distress.

Thirdly, this research explored how veterinarian's perspectives of neurology affect that person's behaviour towards neurological cases and learning. Veterinarians and veterinary students with positive perspectives of neurology were motivated to learn more and see neurological cases, which had the potential to promote confidence through familiarity. However, there were differing behaviours amongst veterinarians with initial negative perspectives of neurology. Interviews revealed that some veterinarians actively seek to overcome their negative affective responses towards neurology by creating opportunities to learn from and be supported by veterinary specialists, and by increasing their exposure to neurological cases to increase familiarity and confidence. These behaviours ultimately resulted in improved perspectives of neurology over time. Other veterinarians preferred to avoid neurological cases, if possible, thereby avoiding the associated negative affective responses but also limiting the potential to learn and gain familiarity. And other veterinarians simply did not perceive a need to advance their learning beyond what they already knew, even if they considered their understanding to be low. Negative perspectives of neurology persisted amongst veterinarians in the latter two groups.

Factors contributing to whether an individual actively pursued greater learning and experience of neurology included: 1) motivation to improve neurological knowledge; 2) reaction to challenge; 3) threat to personal self-worth; and, to some extent, 4) workload. Motivation to improve neurological knowledge was, in turn, dependent on the value placed on neurological competency, whether motivation was internally or externally driven, and mindset and belief in one's ability to improve. Reaction to challenge was linked to motivation and personality factors and traits. For some individuals, challenge was a positive driving force that stimulated effort to improve. For others, challenge was enjoyed but only under certain conditions. While there was insufficient opportunity to explore the conditional enjoyment of challenge further, the research findings suggested this might be associated with the need to believe the challenge could be overcome, and therefore associated with a more fixed mindset and maladaptive perfectionism. There was also insufficient opportunity to explore how threats to professional identity translated into threats to personal identity and self-worth. However, comments made by some interviewed veterinarians suggested this to be a very real and emotionally difficult concern. The difficulties encountered by workload were raised by both veterinarians and veterinary students. For some, workload prevented further learning even if it was desired. In the undergraduate cohort, workload (volume to learn, limited time) was the main reason veterinary students learned neurology through superficial or strategic approaches.

Finally, this research sought to understand how a veterinarian's perspectives and experiences of neurology compare with their perspectives and experiences of other veterinary disciplines. Reasons non-neurological disciplines were enjoyed, or not enjoyed, were similar to reasons neurology was or was not enjoyed. Emotional comfort (influenced by factors such as familiarity, confidence in understanding and application, and self-belief) and control, and feeling they had made a positive difference, were important factors in determining whether veterinarians enjoyed or did not enjoy a discipline. Correspondingly, veterinarians who worried about mistakes, and felt they did not know enough, had insufficient experience, or were pushed into acting before they had time to think were more likely to dislike/avoid neurology. Amongst veterinary students, feelings of comfort and control were also important in determining enjoyment of a subject, but interest was the main driving factor. For many students, interest was contingent on the way subjects were presented by their lecturers. Overall, neurology was considered interesting by most veterinary students, a finding echoed by veterinarians. One apparent difference between some veterinarians' and veterinary students' perspectives of neurology and non-neurological disciplines related to conditional enjoyment of challenge. Veterinarians who disliked/avoided neurology considered neurology equally or more challenging than disciplines they reported they enjoyed because of its challenge. Similarly, veterinary students who liked one discipline because it was challenging, did not necessarily like the challenge of neurology.

As the research progressed, it became clear that exploration of factors underlying affective responses was necessary to understand why differing perspectives of neurology developed. In doing so, the research findings became less specific to neurology and more broadly applicable to other disciplines and experiences the individuals found difficult.

8.2 Research Contribution

The motivation to explore veterinarians' perspectives of neurology arose from my personal resonance with medical literature on neurophobia. However, both critical review of that literature and the findings of this research suggest that what is "known" about neurophobia is likely to be superficial and simplistic, and potentially misleading.

Of prime concern is the tendency to equate neurophobia with the expression of difficulty with neurology. In accordance with implications arising from previous medical education research (Albert et al., 2016; Burford et al., 2019; Gupta et al., 2013; Lukas et al., 2017; Poser, 1959; Vaou & Sader, 2019), veterinarians and veterinary students in my cohorts expressed enjoyment of the challenge posed by neurology and neurological cases. For some veterinarians, challenge was a driving factor for improvement. Furthermore, most surveyed veterinary students considered neurology challenging to understand or apply, with students who enjoyed neurology as likely to select this option as students who disliked/avoided neurology. This suggests that even if challenge is not an attractant towards neurology, it is not necessarily a deterrent either. Such findings highlight that it is inappropriate to consider individuals neurophobic simply for perceiving neurology as difficult.

Until now, the focus on difficulty has primarily related to intellectual difficulties understanding and applying neurology. Although research has touched on factors linked to affective responses, such as anxiety (Ansakorpi et al., 2017) and threats of litigation (Gentile et al., 2020; Nash et al., 2004), there has been very little exploration of affective difficulties relating to learning or applying neurology. My data suggests that it is not necessarily the intellectual difficulty that promotes negative perspectives of neurology, but rather how an individual feels when facing that difficulty.

It could be argued that greater understanding of affective responses to neurology is unnecessary, and that it does not matter what causes difficulty with neurology, only that difficulty is perceived to be present. However, many studies in medical education have focused on developing interventions to improve individuals' perspectives of neurology (for example, Abushouk and Duc, 2016; Charalambous et al., 2015; McColgan et al., 2013; McGovern et al., 2021; and Shiels et al., 2017). If the intention of an intervention is to reduce the incidence of neurophobia and change negative perspectives, the intervention needs to address the cause of the negative perspective. Multiple interventions have targeted intellectual learning through concentrated neurology or neuroscience courses (for example, Arantes et al. (2017), Frey et al. (2021), and Togher et al. (2021), like the short courses undertaken by some veterinarians in this research. Such courses may provide some comfort and improve perspectives towards neurology but, based on my findings, are unlikely to create a marked or lasting shift in perspective.

The research presented in this thesis identified sentiments akin to those expressed in moral distress. The concept of moral distress has not previously been applied to situations in which internal constraints, such as lack of confidence or knowledge, prevent an individual from acting. However, the experience of wanting to act but feeling incapable of acting due to such internal constraints resurfaced multiple times amongst my interviewed cohort. Additionally, these comments were associated with strong negative affective responses, that often suggested that self-worth had been undermined. I have therefore proposed that the model of moral distress is equally applicable to situations in which an individual is unable to act due to internal constraints, and equates to a model of emotional distress. In situations of emotional distress the strength of affective responses and threat to one's self-worth and identity may even be greater as there is no external focus for blame.

The current research suggests that personal values and personality traits will influence how much effect intellectual interventions have on changing a veterinarian's perspective of neurology. While increased understanding of neurology is likely to lessen negative affective responses towards the subject and neurological cases, it may not address distress associated with intolerance of uncertainty (due to barriers obtaining a diagnosis), internal conflict, and identity threats. Additionally, it is unlikely to lessen negative affective responses associated with emotional distress or change how one reacts when faced with such distress. Therefore, this research has highlighted possible contributors to neurophobia that have not been previously considered but could contribute to poor or limited responses to educational interventions.

The research was conducted in exploration of neurophobia specifically amongst the veterinary population. However, its deeper analysis of factors underlying reasons for difficulty learning or applying neurology, and reasons for enjoyment and a positive shift in perspectives of neurology, means that the findings are likely applicable to other experiences of difficulty learning. The model for changes in perspectives of neurology that arose from the data (Figure 7.1) could therefore inform future research in other educational settings.

The research also highlighted the contextual nature of tolerance of uncertainty. Significant differences in tolerance of uncertainty were identified between veterinarians with positive and negative perspectives of neurology when uncertainty related to neurology and neurological cases, and when uncertainty related to their general working environment. However, there were no significant differences with regards to median levels of agreement for statements relating to uncertainty in their personal lives or in high stakes situations. These findings indicate that context should be considered when exploring potentially dynamic factors, such as tolerance of uncertainty.

Overall, neurology was considered interesting by most veterinary students, suggesting the potential for more students and veterinarians to enjoy neurology provided they become comfortable in their understanding and application of neurology, familiar with case progression and outcome, and can address negative affective responses associated with internal conflict.

8.3 Limitations of the Research

Limitations particular to each study in this research have been discussed in the correlating results chapters. These included the small numbers of participants, the potential for error when recalling past events, restrictions in the ability to clarify reasons for respondents' answers, and the inability to establish cause *versus* effect.

As noted in previous chapters, data were analysed through my interpretations of cohorts of veterinarians and veterinary students as groups, rather than as individuals. I was systematic in my analysis, interpreted the results based on the theoretical findings of previous educational and psychological literature, and was careful to consider multiple sources of bias including interviewer bias and observer bias. However, my interpretations provide just one possible set of explanations for the data and may not hold true for each individual. The validity of my conclusions will therefore depend on whether they resonate with readers and are supported by future research.

The data identified several factors associated with the development of veterinarians' perspectives of neurology, and suggested the influence of those factors differs between individuals. However, the small sample sizes precluded meaningful multivariable analysis, and these factors were therefore examined individually rather than in combination. As a result, the analysis did not account for how variables might relate to one another, either as confounders or effect modifiers. Without the ability to model interactions or adjust for confounding, some caution is advised when interpreting the outcomes. Future studies with larger sample sizes will be necessary to evaluate the combined and interacting effects of contributing factors and provide a more robust understanding of how attitudes towards neurology develop amongst veterinarians and veterinary students.

To reduce information bias, participants were asked to confirm their attitudes toward neurology at the start of their survey and interview. Survey anonymity is a standard approach, however, it likely also reduced social desirability bias and supported more candid responses, particularly regarding negative attitudes. Anonymity was not possible in interviews but, in most cases, the collegial relationship between interviewer and participant appeared sufficient to encourage openness. Nevertheless, some participants explicitly expressed hesitancy about revealing perceived weaknesses, and others conveyed this indirectly through cautious or qualified language. This hesitancy suggests a degree of self-presentation bias may have been present, driven either by a desire to appear competent to the researcher or by personal discomfort in acknowledging uncertainty.

Findings from the veterinarian interviews informed the subsequent surveys. Most interviewed veterinarians were employed at Massey University or had undertaken further post-graduate education. This could suggest a selection bias towards participants with a greater willingness to learn or desire to be challenged, and limited diversity of voices within the interviewed population. As noted previously, care was taken to provide a wide range of answer options within the questionnaire, including options of “other”. The multiple answer options helped address the potential for inadequate diversity and reduced the potential for misrepresentation of participants’ perspectives. Additionally, the focus on underlying affective responses, traits and values likely minimised potential effects of selection bias. Even amongst veterinarians with similar academic or employment backgrounds, affective responses, traits and values differed between participants with differing attitudes towards neurology.

The interview findings also informed the survey of veterinary students. Most interviewed veterinarians had graduated more than five years prior, meaning their undergraduate experiences may not have been relevant to the experiences of the veterinary students at the time of the surveys. Additionally, the interviewed veterinarians had completed their undergraduate studies in a variety of countries, which could have affected how relevant their responses were to the surveyed veterinary students. However, many of the veterinarians’ comments were similar, no matter where they completed their veterinary training or how long ago they graduated. Survey questions primarily explored the common issues and affective responses raised, while ensuring representation of less common interview findings. Data analysis identified similar affective responses, personality traits, and explanations for difficulty in all three groups of respondents. This was interpreted to indicate the findings identified from the interview data were applicable and relevant despite the potential selection bias amongst interviewed veterinarians; however, it is possible that the coherence of results may have been caused by bias created through the phrasing of the questions. Future evaluation of other populations will be necessary to understand whether my findings and conclusions can be generalised.

Participant numbers were appropriate in the interview phase of this research (see Chapter 4). Not only were the numbers interviewed consistent with recommendations from previous literature, but in the sample of interviewed veterinarians, most experiences and opinions were shared by multiple individuals despite different backgrounds and clinical sector. However, participant numbers in the survey phases were low: 26% total response rate for veterinary students, a response rate cannot be calculated for the veterinary survey due to difficulties obtaining data relating to the number of registered veterinarians in each governing body. It may have been possible to recruit further survey participants had the surveys remained open for longer. However, the lack of pilot data meant the sample sizes required to explore each characteristic of interest were unknown. Further research will benefit from the findings presented in this thesis. These findings can both inform further investigations and the data can be used to calculate sample sizes necessary to achieve statistical power.

Survey participant numbers were further decreased by exclusion of those with indifferent attitudes towards neurology. As discussed in Chapters 5 and 6, these participants were excluded from the primary analysis to sharpen the contrast between those with clearly negative attitudes towards neurology and those with clearly positive attitudes towards neurology, and provide initial insight into the extremes of the attitude spectrum. Interview data suggested that participants indifferent to neurology represent moderate or transitional perspectives, which may play a key role in shaping attitudes. Excluding these participants from the survey analyses limited our understanding of such perspectives but was also considered beyond the scope of this research. Therefore, as discussed in Chapter 7, factors that lent towards development of a neutral perspective of neurology in the model created from the findings of this thesis were based on interview data alone. Although the interview data supported the model, care should be taken when generalising the findings to a wider population until greater evidence has been evaluated through follow-up analysis targeting the perspectives of veterinarians and veterinary students who are indifferent to neurology.

8.4 Implications and Recommendations

The conclusions drawn from this research have implications for both the medical education sector and the veterinary education sector. Firstly, my conclusions question the validity of previous literature on neurophobia by querying the appropriateness of how neurophobia has been measured and, as a result, the efficacy of proposed interventions. Secondly, they raise considerations for the future teaching of neurology and other perceived difficult subjects in the veterinary, and potentially medical, sector. And thirdly, they offer insight into the difficulties faced by veterinarians in clinical practice and how cycles of negativity or positivity might develop.

8.4.1 The validity of previous neurophobia literature

As described in Sections 8.1 and 8.2, my research identified that perspectives of neurology were influenced by affective responses that arose from how experiences of learning and applying neurology aligned with an individual's values and traits. It is therefore unclear whether the more recent instruments to measure neurophobia in medical (McGovern et al., 2021) or veterinary (Murthy et al., 2023) professionals are appropriate to measure dislike/avoidance of neurology. Neither of these instruments evaluates whether the individual enjoys or dislikes neurology, instead focusing on self-reported understanding, confidence, and perceived ability. Results of these instruments risk inaccuracy through not explicitly evaluating the individual's attitude towards neurology. Additionally, there is a well-recognised tendency for high-achievers to underestimate their knowledge and ability (Ehrlinger & Dunning, 2003; Hall et al., 2016; Sawdon & Finn, 2014). As individuals become more aware of their deficiencies, they also recognise their limitations more (Kruger & Dunning, 1999). By not exploring the individuals' affective responses to neurology and their perceived difficulties with neurology, these instruments risk misclassifying individuals who enjoy neurology as neurophobic. The NeuroQ scale is gaining traction as a measure of neurophobia and as an instrument to assess the efficacy of interventions. Therefore, it is important that we determine whether the NeuroQ and VetNeuroQ scales accurately reflect an individual's attitude towards neurology.

It is important to note that my research does not render previous literature on difficulty learning and applying neurology defunct. In my research veterinarians and veterinary students reported many of the difficulties that have been identified in literature on neurophobia, such as the complexity of neurology, insufficient repetition and exposure to theory and cases, and adoption of surface or strategic learning approaches to counter workload and lack of understanding. However, the important distinction is that these external difficulties and some of the internal factors were also reported by individuals who enjoyed neurology. My research identified that it was not the difficulty learning and applying neurology that mattered, but how the individual reacted to that difficulty. Thus, perceived difficulty with neurology does not equate to a negative perspective of neurology and should never be the sole measure of neurophobia.

8.4.2 Considerations for future teaching of neurology

Much of the previous literature on neurophobia has placed the blame for negative perspectives of neurology on the complexity of the subject and a failure of educators and curricula to simplify the subject sufficiently (for example, Ansakorpi et al., 2017; Kam et al., 2013; McCarron et al., 2014; and

Youssef, 2009). Consistent with such reports, my research findings support the need for neurology teaching to focus more on cementing its fundamental concepts, reduce extraneous detail and workload, and increase the ability for students to “see” connections between concepts. However, my research also identified that values, traits and affective responses underpin veterinarians’ and veterinary students’ perceptions of neurology, suggesting that simply apportioning blame to teaching and curricula may not be entirely appropriate.

Blame on teaching and curricula has primarily been based on the comments and responses of learners, many of whom found difficulty with neurology. Covington’s (1984) discussion of self-worth theory noted that, for some, the perception of high ability denotes worthiness. When one’s perception of ability is threatened, self-worth is also threatened. Attribution of failure to an external locus has the potential to save face and avoid risking threat to our self-worth. The desire to protect our self-image can even result in self-handicapping, purposefully adopting strategies that provide us with excuses for failure in the event that it occurs (Kearns et al., 2008; Schwinger et al., 2022). However, by laying blame for difficulty with a subject on factors outside one’s control we are also provided with an excuse to avoid addressing both our intellectual and affective difficulties, which may perpetuate negative feelings.

My data suggested that the value the individual placed on a successful outcome learning or applying neurology influenced how they responded to both achieving that outcome and to failure. This raises several points worthy of consideration with regards to the teaching of neurology: 1) how can we increase the perceived value of learning and/or applying neurology; 2) how can we increase perceptions of achievement and reduce perceptions of failure; and 3) how can we shape the development of learners’ identities so that perceptions of success are not contingent on the final outcome?

Participants often noted that the relevance (or lack of relevance) of neurology knowledge and ability to apply that knowledge influenced the value that they placed on the discipline. A perceived lack of relevance typically led to boredom and low motivation to learn. The relevance of neurology amongst veterinary sectors is primarily dictated by willingness of owners to pursue diagnostic investigation and treatment for neurological cases, and the frequency of neurological disease amongst animals in that sector. While the perception of relevance may be difficult to alter, motivations other than relevance were also reported by participants, such as the level of interest in a subject. Further investigations would be needed to better understand how we might make neurology more interesting for students, but possibilities could include greater involvement of students in clinical cases, the creation of enjoyable neurological “puzzles” for students to solve through application of knowledge, or discussions of how knowledge of veterinary neurology might help explain clinical signs or common human neurological conditions that students are aware of, and *vice versa*.

Amongst participants, perceptions of achievement and failure did not solely depend on the final outcome of a learning assessment or clinical case. Perceptions of success and failure also depended on the individual's perceived personal contribution to that outcome (i.e. external *versus* internal attribution of success/failure) and whether elements of success could be recognised in the process of reaching the final outcome. Attribution of success to external factors tended to cheapen or negate feelings of success, while attribution of failure to external factors could protect self-worth but limit personal growth and create negative perceptions, such as unfairness. In a learning environment, outcome often hinges on assessment. The influence of that assessment on perceptions of success and failure should not be downplayed. Assessments should reflect what students believe to be a fair representation of what they have learned, reducing the potential influence of chance on the outcome. Students should be provided with ample practice opportunities and opportunities for constructive feedback, creating a supportive learning environment, familiarity to help reduce anxiety in assessment situations, and belief that achievement is possible. Such an environment may also aid in reflection during times of failure to help students learn from their mistakes and see the achievements they have made despite the negative final outcome.

Higher education students that have greater familiarity with the beliefs, values, practices, norms, responsibilities and performance standards of their intended profession demonstrate stronger professional identity (Tomlinson & Jackson, 2021). Much of an individual's perception of what the veterinary profession is will depend on societal expectations, personal beliefs and previous experiences of the profession. However, educators also play a role in establishing students' ways of thinking and how they view the values of the profession. Therefore, educators should look beyond academic assistance and consider their influence on how and what students think, and how they shape students' perceptions of the veterinary profession. This includes how students perceive and react to difficulty. Perspectives of neurology might be improved by targeting aspects of identity development, such as the influence of the hidden curriculum (Roder & May, 2017), to enhance awareness of and capability to resolve emotional distress and gain emotional comfort. Explicit discussion of traits such as imposter phenomenon and perfectionism, lecturers sharing their own learning difficulties, and peer discussions of difficulties and how to overcome them should also be considered, to normalise feelings of difficulty. Recognition that others experience difficulty might help to reduce perceptions of not being good/smart enough and encourage individuals to seek help or engage in further education to address their deficits in knowledge and practical application. Additionally, although it has been recommended that educators should balance the creation of a shared identity (to aid understanding of each other, and our roles in the community) and maintaining autonomy so that diversity exists (Spinner-Halev, 2005), we should consider being more explicit in increasing student awareness of successful outcomes beyond the final patient outcome. It has been shown that veterinarians with an academic diagnosis-focused identity exhibit poorer emotional health, while those with a challenge-focused identity exhibit greater emotional well-being (Armitage-Chan & May, 2018). Similarly, participants in my research who found success in the process of learning and case management, rather than just from the final outcome, exhibited more positive perspectives of neurology. Ultimately, individuals who tend towards a more rigid diagnosis-focused identity may be better served, both as students and in their subsequent careers, by educators who demonstrate and discuss the feelings of success and emotional benefit that can be gained from a focus on challenge or the process of learning.

Veterinarians and veterinary students identified lack of repetition as a cause of difficulty. Lack of repetition might also contribute to the limited benefits of short neurology courses on improving veterinarians' perspectives of neurology. In many veterinary clinics, including teaching hospitals, veterinarians' and veterinary students' exposure to specific clinical conditions is dependent on factors such as social and economic demographics, the make-up of the local animal population, and seasonality. Clinical conditions that are frequently seen in one clinic may be rare in another. It is therefore difficult to provide standardised cases for learning and spaced repetition of clinical conditions to maintain familiarity. Increasing case-based learning opportunities could provide repetition, allow for spaced repetition and standardise case examples, provided learners are encouraged to apply their knowledge. Neurology is well-suited to such case-based learning due to the importance of visual interpretation of the neurological examination. Interpretation of video footage requires learners to apply knowledge of functional neuroanatomy and neurophysiology in a clinical setting, increasing familiarity and helping cement fundamental knowledge. New curricula frameworks, such as competency-based veterinary education which promotes application of knowledge, could therefore prove beneficial in improving veterinary students' understanding of, and familiarity, with neurology.

My research suggests that we likely need a two-pronged approach to improve perspectives of neurology; a focus on improved affective responses towards learning and applying neurology even when difficulty is encountered, and steps to increase understanding of basic neurological concepts and how these apply to a clinical situation, which may additionally reduce threats to individuals' self-worth and identity. There are currently no studies evaluating interventions to improve perspectives of neurology in the veterinary profession. Addressing difficulties learning, understanding, and applying neurology could increase the prevalence of positive perspectives of neurology but it is likely that additional strategies will be necessary to guide individuals towards a sustainable and better fitting professional and personal identity. The affective factors, values and traits identified in my research, and the occurrence of and ability to resolve emotional distress, should be considered in the design of future interventions. Additionally, investigation of whether such contributors are also present in medical education is warranted.

8.4.3 The development of cycles of negativity and positivity

In my research, a greater proportion of veterinarians disliked/avoided neurology than veterinary students. This might simply reflect differences between the groups surveyed, or it could indicate a real difference due to positive changes in teaching approach and curricula or a tendency for perspectives of neurology to decline following graduation. My research identified possible reasons for the latter, including the effects of a changing identity amongst new and recent graduates and the potential for encountering role conflict. We know that new graduates may find it simpler to compartmentalise their identity than develop a new identity that encompasses their new role. This can cause dissociation of their professional identity from their personal identity and adoption of multiple context-driven identities (Nyström, 2009). Identity compartmentalisation can result in decreased ability to reflect on the situation in context thereby slowing and limiting the development of identity, emotional instability caused by switching between one's identities, and a tendency to focus on technical competence (Armitage-Chan, 2020; Armitage-Chan & May, 2018; MacIntosh, 2003; Pratt et al., 2006). The risk of internal conflict, and therefore emotional distress, when encountering challenge to one's abilities and knowledge might therefore be higher early in one's career during this phase of identity development. We don't know whether an additional element of internal conflict or associated emotional distress makes such challenging experiences more memorable or more difficult to reconcile. Further research to evaluate the effect of such distress on new graduate experiences of veterinarians and the longevity of emotional discontent from these experiences could provide important insights into both the development of veterinarians' perspectives and veterinarians' mental health.

Availability of support for neurological cases, or a lack of support, was discussed by multiple veterinarians as a contributor to their comfort with the discipline. Support enables growth of understanding through addressing the effects of secondary ignorance (lack of experience meaning one doesn't know what they don't know) and sharing experiential learning to highlight associations between theoretical knowledge and clinical application, aid retention through contextual relevance, and serve as warnings (Benner et al., 2009). Discussion of one's own mistakes may also stimulate reflection, and aid learning from and acceptance of the experience. Without such support, individuals may struggle to improve their understanding of and approach to cases and be unable to address negative emotional experiences.

One likely difficulty in implementing appropriate support networks to support veterinary students and veterinarians with neurology is the barriers some individuals experience in asking for help. Veterinary students who considered it unimportant to appear to know what they were talking about were significantly less likely to dislike/avoid neurology. It is possible that these students were more willing to seek help. In contrast, individuals that prioritise maintaining the appearance of high ability may be reluctant to communicate their deficiencies to others, even if that means not receiving the support they need. The way an individual is seen by others, or perceives themselves as seen by others, can influence how they see themselves, particularly amongst those who have adopted an identity that may not fit them well (Kroger & Marcia, 2011). This may be reflected in veterinarians' need for approval from important stakeholders, such as their clients (Clarke & Knights, 2018). The influence of social interaction on identity is well-recognised (Kroger & Marcia, 2011; Nyström, 2009). Feedback, positive or negative, has different meaning when coming from a trusted source versus an untrusted source (Katz & Kahn, 1966). For some, this may make it difficult to see their performance from an alternate view, instead trusting more in their own perception of success or failure no matter how erroneous that perception is. Trusted feedback may also result in a greater or longer-lasting effect of words or actions, particularly when it comes from individuals in a power position. Negative affective responses such as shame and humiliation may therefore persist if trusted feedback is delivered without due consideration.

The implications of a lack of appropriate support, or engagement with support, may be enormous. Firstly, inability to resolve confusion or feelings of failure, and improve understanding could inhibit development of professional identity and create dissonance between professional identity and professional experiences. Secondly, if new graduates' deficits in understanding and emotional needs are not addressed, they in turn will not be able to support future new graduates, perpetuating these gaps in understanding and negative emotions. Thirdly, support in the context of social and hands-on learning also provides opportunities to learn from the experiences and actions of others, improving skills and self-confidence. Additionally, role modelling can aid in the setting of realistic goals, thereby aiding identity development. In contrast, learning through descriptions, such as those found in textbooks, has been suggested to be insufficient to achieve skilled performance (Benner et al., 2009), potentially disadvantaging those without appropriate support.

My research echoes concerns that have been raised for many years regarding the potential for insufficient veterinary new graduate support (Gardner & Hini, 2006; Gates et al., 2020; O'Connor, 2019; Routly et al., 2002). In such situations, new graduates may not be afforded the opportunity to learn from the collective knowledge of their professional and social group. This collective knowledge is more than just theory, "collaborative and cooperative teamwork allows the pooling of expertise and creates a climate of support and possibility that can combat the threat of helplessness in the face of grave, critical solutions" (Benner et al., 2009, p. 235). The pooling of expertise, and the influence of social cues from others within the team unit, can therefore provide considerable support. However, we should also consider the implications for how the values of one's social group might negatively influence an individual's expectations of themselves (through comparison or alignment with negative social attitudes), and perceptions of professional identity and a specific discipline. Social groups can influence their members' perspectives, shaping what knowledge and skills are valued, or not valued, and determining what skills are developed and passed on (Benner et al., 2009). As a result, social influences also risk impeding the learning of neurology and promoting negative perspectives of neurology. Participants in my research discussed exposure to negative portrayals of neurology by both colleagues and lecturers, and in the medical literature negative perspectives of neurology have been associated with teaching of neurology by non-neurologists (Schon et al., 2002). Therefore, support can also prove detrimental to the development of positive perspectives of neurology if it encourages individuals to view the discipline negatively. Further research into how best to provide appropriate and positive support to break the cycle of negativity is warranted. Until we better understand what type of support is most beneficial to new graduates, educators should encourage final year students to reach out for help and create a supportive, non-judgemental environment for this.

8.4.4 Further implications for research

The deeper exploration of reasons underlying veterinarians' and veterinary students' perspectives of neurology lessened the specificity of the findings. However, it enabled identification of further areas worthy of research.

Firstly, previous research has suggested that veterinarians' professional and personal identities are closely intertwined. Comments made by some interviewed veterinarians suggested this to be a very real and emotionally difficult issue as threats to professional identity translated into threats to personal identity and self-worth. This is an important consideration beyond our understanding of development of perspectives towards different disciplines. An inability to separate professional and personal identities risks more profound internal conflict, emotional distress, and negative effects on mental health. Further research is warranted to better understand how common it is for veterinarians and veterinary students to separate their professional and personal identities, the reasons why this may or may not occur, and the consequences of failing to separate these identities.

Secondly, conditional enjoyment of challenge was repeatedly noted amongst the different cohorts in this research. It is unlikely that conditional enjoyment of challenge applied only to dislike/avoidance of neurology. Rather, it likely represents an impediment to overcoming difficulty in any context. A better understanding of the reasons underlying conditional enjoyment of challenge may be valuable when designing educational interventions and curricula.

Thirdly, the data suggested there are other factors contributing to the development and persistence of perspectives of neurology that could not be investigated in this research. Further evaluation of the potential contribution of factors such as impostor phenomenon, the effect of previous high achievement when encountering difficulty, and risk aversion, and greater exploration of the roles of perfectionism, mindset, and intolerance of uncertainty, as well as the associations between these factors, would increase our understanding of the non-intellectual contributors to perspectives of neurology.

Lastly, this research proposed possible non-intellectual contributors to the development of perspectives of difficult subjects. Whether these findings can be generalised requires further exploration.

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Willis, A. S. (2018). The Efficacy of Phenomenography as a Cross-Cultural Methodology for Educational Research. *International Journal of Research & Method in Education, 41*(5), 483-499. https://doi.org/10.1080/1743727x.2017.1283398

Wright, E., & Osman, R. (2018). What Is Critical for Transforming Higher Education? The Transformative Potential of Pedagogical Framework of Phenomenography and Variation Theory of Learning for Higher Education. *Journal of Human Behavior in the Social Environment, 28*(3), 257-270. https://doi.org/https://doi.org/10.1080/10911359.2017.1419898

Ybarra, O. (2001). When First Impressions Don't Last: The Role of Isolation and Adaptation Processes in the Revision of Evaluative Impressions. *Social Cognition, 19*(5), 491-520.

Young, C. B., Wu, S. S., & Menon, V. (2012, May 1). The Neurodevelopmental Basis of Math Anxiety. *Psychological Science, 23*(5), 492-501. https://doi.org/10.1177/0956797611429134

Youssef, F. F. (2009, Jul 1). Neurophobia and Its Implications: Evidence from a Caribbean Medical School. *BMC medical education, 9*, 39. https://doi.org/10.1186/1472-6920-9-39

Zadra, J. R., & Clore, G. L. (2011, Nov). Emotion and Perception: The Role of Affective Information. *Wiley interdisciplinary reviews: cognitive science, 2*(6), 676-685. https://doi.org/10.1002/wcs.147

Zeki, S. (2013, 6. April). Neurophobes and Their Neurophobia *Prof Zeki's Musings*. https://profzeki.blogspot.com/2013/04/neurophobes-and-their-neurophobia.html

Zenner, D., Burns, G. A., Ruby, K. L., DeBowes, R. M., & Stoll, S. K. (2005). Veterinary Students as Elite Performers: Preliminary Insights. *Journal of veterinary medical education, 32*(2), 242-248. https://doi.org/10.3138/jvme.32.2.242

Appendix A: Systematic Review, Interview and Survey Information

Systematic review: primary studies included for evaluation of characteristics of neurophobia

Table A.1 The 44 primary studies reporting healthcare professionals' or healthcare students' perspectives of neurology that were included in the review of stated definitions, antecedents, attributes and outcomes of neurophobia.

Primary studies evaluating the perspectives of healthcare professionals or students towards neurology and claiming whether neurophobia or anxiety towards neurology was present in their study population (*n* = 24)

Neurophobia, or stated aspects of neurophobia, claimed to be present (*n* = 21)

Aljthalin, R. A., Aljthalin, R. A., Aljagwani, A. S., Alanazi, D. A., Almeflh, B. A., & Alharbi, A. O. (2019). Perceptions and Satisfaction of Saudi Medical Students with Neurology Education: A National Exploratory Study. Dr. Sulaiman Al Habib Medical Journal, 1(3), 83-87. 10.2991/dsahmj.k.190820.001

Ansakorpi, H., Sumelahti, M.-L., & Kaasila, R. (2017). Medical students' experience of emotions and success in neurological studies–What do they tell us? *BMC medical education, 17*(1), 68. 10.1186/s12909-017-0905-4

Bergden, J., Immekus, J., Sawning, S., Carr, E., & Brueckner-Collins, J. (2020). Neurophobia: Anxiety and Self-Efficacy Related to Learning Neuroanatomy in a Medical Student Population. The FASEB Journal, 34(S1), 1-1. 10.1096/fasebj.2020.34.s1.05807

Burford, C., Alexander, E., Sloper, W., & Huett, M. (2017). Factors influencing interest in the brain-related sciences in a UK cohort. J Neurol Sci, 377, 77-78. 10.1016/j.jns.2017.03.043

Burford, C., Hanrahan, J., Ansaripour, A., Smith, B., Sysum, K., Rajwani, K., Huett, M., Vergani, F., Zebian, B. (2019). Factors influencing medical student interest in a career in neurosurgery. World neurosurgery, 122, e367-e374. 10.1016/j.wneu.2019.01.268

Chua, L. Y., Yahya, N., Khairuddin, S. H. S., Mohamad, N. F., Jaganathan, P., Hoo, F. K., Sulaiman, A.W., Ching, S. M., Lee, K. W. (2020). Neurophobia among family medicine specialist trainees in Malaysia. Neurology Asia, 25(3), 367-376.

Fantaneanu, T. A., Moreau, K., Eady, K., Clarkin, C., DeMeulemeester, C., Maclean, H., & Doja, A. (2014). Neurophobia inception: a study of trainees' perceptions of neurology education. Can J Neurol Sci, 41(4), 421-429. 10.1017/s0317167100018436

Flanagan, E., Walsh, C., & Tubridy, N. (2007). 'Neurophobia'–attitudes of medical students and doctors in Ireland to neurological teaching. European journal of neurology, 14(10), 1109-1112. 10.1111/j.1468-1331.2007.01911.x

Giles, J. (2010). Clinical neuroscience attachments: a student's view of 'neurophobia'. *The clinical teacher*, *7*(1), 9-13.

Gupta, N. B., Khadilkar, S. V., Bangar, S. S., Patil, T. R., & Chaudhari, C. R. (2013). Neurology as career option among postgraduate medical students. Ann Indian Acad Neurol, 16(4), 478-482. 10.4103/0972-2327.120427

Kam, K. Q., Tan, G. S., Tan, K., Lim, E. C., Koh, N. Y., & Tan, N. C. (2013). Neurophobia in medical students and junior doctors - blame the GIK. Ann Acad Med Singapore, 42(11), 559-566. 10.1212/wnl.78.1_meetingabstracts.p07.246

Kamour, A. H., Han, D. Y., Mannino, D. M., Hessler, A. B., & Kedar, S. (2016). Factors that impact medical student and house-staff career interest in brain related specialties. Journal of the neurological sciences, 369, 312-317. 10.1016/j.jns.2016.08.046

Loftus, A. M., Wade, C., & McCarron, M. O. (2016). Primary care perceptions of neurology and neurology services. Postgraduate medical journal, 92(1088), 318-321. 10.1136/postgradmedj-2015-133683

McCarron, M. O., Stevenson, M., Loftus, A. M., & McKeown, P. (2014). Neurophobia among general practice trainees: the evidence, perceived causes and solutions. Clinical Neurology and Neurosurgery, 122, 124-128. 10.1016/j.clineuro.2014.03.021

McGovern, E., Louapre, C., Cassereau, J., Flamand-Roze, C., Corsetti, E., Jegatheesan, P., Bendetowicz, D., Giron, C., Dunoyer, M., Villain, N., Renaud, M-C., Sauleau, P., Michel, L., V´erin, M., Worbe, Y., Falissard, B., Roze, E. (2021). NeuroQ: A neurophobia screening tool assesses how roleplay challenges neurophobia. Journal of the neurological sciences, 117320. 10.1016/j.jns.2021.117320

Medina, M., Lee, D., Garza, D. M., Goldwaser, E. L., Truong, T. T., Apraku, A., Cosgrove, J., Cooper, J. J. (2019). Neuroimaging Education in Psychiatry Residency Training: Needs Assessment. Academic Psychiatry, 44(3), 1-5. 10.1007/s40596-019-01156-1

Midik, O., Yalcin, B. M., Yalcin, E., & Ozturk, O. (2017). Neurophobia: a myth or an unpleasant fact for primary care physicians. Biomedical Research, 28(10), 4610-4617.

Santos-Lobato, B. L., Magalhães, Á. B., Moreira, D. G., Farias, F. P., Porto, L. K., Pereira, R. B., Custódio, S.S., Braga, T. K. K. (2018). Neurophobia in Brazil: Detecting and Preventing a Global Issue. Revista Brasileira de Educação Médica, 42(1), 121-128. 10.1590/1981-52712015v41n3rb20160105

Shiels, L., Majmundar, P., Zywot, A., Sobotka, J., Lau, C. S. M., & Jalonen, T. O. (2017). Medical student attitudes and educational interventions to prevent neurophobia: a longitudinal study. BMC Med Educ, 17(1), 225. 10.1186/s12909-017-1055-4

Walker, K. (2013). University students' perceptions of neurology and experiences of learning neurological physiotherapy. (EdD), University of East Anglia, Norwich.

Youssef, F. F. (2009). Neurophobia and its implications: evidence from a Caribbean medical school. BMC Med Educ, 9, 39. 10.1186/1472-6920-9-39

Anxiety towards neurology claimed to be present (*n* = 1)

Birkett, M., & Shelton, K. (2011). Decreasing neuroscience anxiety in an introductory neuroscience course: an analysis using data from a modified science anxiety scale. Journal of Undergraduate Neuroscience Education, 10(1), A37.

Neurophobia claimed to **not** be present (*n* = 2)

Conway, S., & Tubridy, N. (2018). “Neurophobia”: More nurture than nature? Irish Medical Journal, 111(3). Accessed: https://imj.ie/neurophobia-more-nurture-than-nature/

Nordin, N. A. M., Ishak, N. A., AZMI, N. A., Chui, C. S., & Hassan, F. H. (2018). Does Neurophobia Exist Among Rehabilitation Sciences Students? A Survey At Universiti Kebangsaan Malaysia. Jurnal Sains Kesihatan Malaysia (Malaysian Journal of Health Sciences), 16 10.17576/jskm-2018-27

Primary studies evaluating of healthcare professionals or students towards neurology but not clearly claiming whether neurophobia was present in their study population (*n* = 20)

Abulaban, A. A., Obeid, T. H., Algahtani, H. A., Kojan, S. M., Al-Khathaami, A. M., Abulaban, A. A., Bokhari, M.f., Merdad, A.A., & Radi, S. A. (2015). Neurophobia among medical students. Neurosciences Journal, 20(1), 37-40.

Alhejaili, M. A., Alrashedi, M. H., Alatawi, A. N., Alenezi, M. F., Albalawi, K. A., & Albalawi, M. F. (2018). Assessment of attitude and perception toward neurology and neurosurgery specialties among medical students and interns attending College of Medicine at University of Tabuk in Tabuk City, Saudi Arabia-2017. The Egyptian Journal of Hospital Medicine, 71(4), 2960-2962.

Ali, H. A., Alebeed, M., & Bakhit, Y. H. Y. (2021). Neurophobia: How Do Sudanese Medical Students Perceive Neurology-A Cross-sectional Study. Retrieved from https://doi.org/10.21203/rs.3.rs-267339/v1

Al Sharqi, A., Al-Saadi, T. (2018). Attitudes and perceptions of Omani medical students and interns toward neurosurgery: a cross-sectional study. Am J Clin Neurol Neurosurg, 3(1), 5-11.

Elnaeim, M., Babiker, I., Elnaeim, A. (2019). Neurophobia among medical students in Sudan. EC Neurology, 11, 340-345. 10.1016/j.jns.2021.119736

Barat, A., Goldacre, M. J., & Lambert, T. W. (2019). Junior doctors' early career choices do not predict career destination in neurology: 40 years of surveys of UK medical graduates. BMC medical education, 19, 1-9. 10.1186/s12909-019-1650-7

Hall, S., Stephens, J., Parton, W., Myers, M., Harrison, C., Elmansouri, A., Lowry, A., & Border, S. (2018). Identifying medical student perceptions on the difficulty of learning different topics of the undergraduate anatomy curriculum. Medical Science Educator, 28, 469-472. 10.1007/s40670-018-0572-z

Humbert, K. A., & Chang, B. S. (2014). In the beginning: how medical students choose (or do not choose) neurology. Annals of Neurology, 75(4), 487-489. 10.1002/ana.24133

Javaid, M. A., Chakraborty, S., Cryan, J. F., Schellekens, H., & Toulouse, A. (2018). Understanding neurophobia: Reasons behind impaired understanding and learning of neuroanatomy in cross-disciplinary healthcare students. Anatomical sciences education, 11(1), 81-93. 10.1002/ase.1711

Lukas, R. V., Cooper, B., Morgan, I., Brorson, J. R., Dong, H., & Sherer, R. (2014). Attitudes toward neurosciences in medical students in Wuhan, China: a survey study. World Neurosurgery, 82(3-4), 266-269. 10.1016/j.wneu.2014.06.025

Matthias, A. T., Nagasingha, P., Ranasinghe, P., & Gunatilake, S. B. (2013). Neurophobia among medical students and non-specialist doctors in Sri Lanka. BMC Med Educ, 13, 164. 10.1186/1472-6920-13-164

Nguyen, T., Pavitt, S., Wusthoff, C., & Rassbach, C. (2019). Breaking a Cycle of Dependence to Improve Neurology Education: A Qualitative Study Exploring Pediatric Residents' Perspectives. Clinical Pediatrics, 58(11-12), 1158-1165. 10.1177/0009922819870557

Pakpoor, J., Handel, A. E., Disanto, G., Davenport, R. J., Giovannoni, G., Ramagopalan, S. V., & Association of British, N. (2014). National survey of UK medical students on the perception of neurology. BMC Med Educ, 14, 225. 10.1186/1472-6920-14-225

Pokryszko-Dragan, A., Mottershead, J., & Aitken, G. (2019). Attitudes towards neurology among medical undergraduates. Neurologia i Neurochirurgia Polska, 53(1), 61-73. 10.5603/PJNNS.a2018.0004

Ridsdale, L., Massey, R., & Clark, L. (2007). Preventing neurophobia in medical students, and so future doctors. Pract Neurol, 7(2), 116-123.

Sánchez-Jordán, A., Medina-Rioja, R., Díaz-Peregrino, R., & Cantú-Brito, C. (2017). Panorama of neurophobia in Mexico. Revista Mexicana de Neurociencia, 18(2), 6-16.

Sanya, E. O., Ayodele, O. E., & Olanrewaju, T. O. (2010). Interest in neurology during medical clerkship in three Nigerian medical schools. BMC Medical Education, 10, 1-6. 10.1186/1472-6920-10-36

Schon, F., Hart, P., & Fernandez, C. (2002). Is clinical neurology really so difficult? J Neurol Neurosurg Psychiatry, 557-559. 10.1136/jnnp.72.5.557

Vaou, O., & Sader, E. (2019). Top 5 Reasons Not to Choose Neurology as a Career (P2. 9-037). Neurology, 92(15_supplement), P2-9. 10.1212/wnl.92.15_supplement.p2.9-037

Zinchuk, A. V., Flanagan, E. P., Tubridy, N. J., Miller, W. A., & McCullough, L. D. (2010). Attitudes of US medical trainees towards neurology education:" Neurophobia"-a global issue. BMC medical education, 10, 1-7. 10.1186/1472-6920-10-49

Interview information sheet

Veterinarians' perspectives of neurology and the neurosciences

INFORMATION SHEET

Information Regarding the Researchers

My name is Anita Shea, and I am a veterinary neurologist with an interest in veterinary education. I am undertaking a doctoral thesis evaluating the attitudes of veterinarians towards neurology and neurological veterinary cases, under the supervision of Associate Professors Naomi Cogger and Liz Norman (College of Sciences).

Project Description

This interview study will investigate veterinarians' experiences of neurological cases and their perceptions of and attitudes towards neurology as a discipline. Anecdote suggests that veterinarians have a range of attitudes from those who love neurology, those who would avoid it if given the chance, and everything in between. My research seeks to determine whether this anecdotal impression is correct and identify reasons for different attitudes. Ultimately, I hope the findings will improve our approach to veterinary education in the areas of neuroscience and clinical neurology.

Invitation to Participate

I am seeking veterinarians currently employed by or studying at Massey University, as well as veterinary neurology specialists, to volunteer to participate in one-on-one interviews. I am looking for participants with a range of attitudes towards neurology and I would like to invite you to participate in this research. You have received this invitation as you are on listservers for the School of Veterinary Science at Massey University or the webpage of the European College of Veterinary Neurologists. I am currently recruiting participants who **hold a veterinary degree and can recall some experiences of clinical neurological cases.**

Project Procedures

Should you choose to take part in this study, this is what is involved:

- Participation in a one-on-one interview about your experiences of neurology and your attitude towards the discipline. **This interview is expected to take approximately one hour** and will be conducted at a mutually convenient time, in a mutually convenient location or via Zoom.

- Interviews will be audio recorded and fully transcribed, with field notes taken during the interview. You will be provided with a transcribed copy of your interview to review, should you wish to do so. This review is not mandatory, however return of a signed transcript release form will be required for the data you provided to be included in the study.
- I may request further contact with you to clarify details or obtain follow-up data. You will be advised what this would entail, and the potential time commitment required. You are under no obligation to consent to this.

The study is anonymised, however given that the constituents of the veterinary population at Massey University and the European College of Veterinary Neurology are publicly advertised, it may be possible for you to be identified through your answers by someone who knows you well. The study will assess perspectives not competency; any risk to your reputation is deemed low and results should not pose a risk to your employment status.

Data Management

Data will be anonymised. Data collected for this research will be kept securely on my password-protected computer and Massey-contracted OneDrive. Hard copies of the consent forms will be kept in a locked office. Raw data will be destroyed after five years.

The study findings will be available in my Doctoral thesis and disseminated to the academic and veterinary community in conference presentations and peer-reviewed publications.

Participant Benefits

Participation in this study will enable your personal experiences of veterinary neurology to contribute to the understanding of how the discipline is viewed by veterinarians, and why different perspectives develop. In future, these findings may be used to improve the educational approach to veterinary neurology both in New Zealand and overseas

You are under no obligation to accept this invitation. If you participate, you have the right to:

- decline to answer any particular question;
- ask for the recorder to be turned off at any time during the interview;
- withdraw from the study at any stage up to data analysis;
- ask any questions about the study at any time during participation;

- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.

Project Contacts

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

Anita Shea	Assoc. Prof. Naomi Cogger	Assoc. Prof. Liz Norman
A.Theobald1@massey.ac.nz	N.Cogger@massey.ac.nz	E.J.Norman@massey.ac.nz
	extension: 85147	extension: 85115

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application 21/07. If you have any concerns about the conduct of this research, please contact Dr Negar Partow, Chair, Massey University Human Ethics Committee: Southern A, telephone 04 801 5799 x 63363, email humanethicsoutha@massey.ac.nz.

Interview consent forms for participation and transcript release

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

SCHOOL OF VETERINARY SCIENCE
TĀWHARAU ORA

Veterinarians' perspectives of neurology and the neurosciences

PARTICIPANT CONSENT FORM – INDIVIDUAL

I have read and I understand the Information Sheet attached. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time by contacting the researcher at A.Theobald1@massey.ac.nz

1. I agree/do not agree to the interview being sound recorded.

2. I wish/do not wish to have my recordings returned to me. (Please note that you will receive a copy of your interview transcript as part of the study. This statement refers to the audio recording of the interview.)

3. I agree to participate in this study under the conditions set out in the Information Sheet.

Declaration by Participant:

I, [print full name] ___________________________________ hereby consent to take part in this study.

Signature: _______________________________________ Date: ___________________________

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

SCHOOL OF VETERINARY SCIENCE
TĀWHARAU ORA

Veterinarians' perspectives of neurology and the neurosciences

AUTHORITY FOR THE RELEASE OF TRANSCRIPTS

I confirm that I have had the opportunity to read and amend the transcript of the interview(s) conducted with me.

I agree that the edited transcript and extracts from this may be used in reports and publications arising from the research.

Signature: .... **Date:** ....

Full Name - printed ....

Interview Questions

Participant background

1. Before we start talking about neurology, could you please tell me about your clinical experience as a vet so far?
2. Why did you choose this career? Why did you make the career choices that you made?

Narratives of cases that were perceived positively/negatively, exploring what happened and how they felt about it

3. Firstly, I would like you to think about a neurological case that you have dealt with. Please can you tell me about the first case that springs to mind?
4. Can you please tell me about a case that went well/did not go so well (*the opposite of Q3*)? Again, please discuss the first case that comes to mind.

Understanding/conceptualisation of neurology as a subject

5. Please tell me about your overall view of neurology as a subject.
6. What do you think is the most important aspect of managing/approaching a neurological patient?
7. How would you know if you have been successful with a neurological patient?

Opinions of neurology as a discipline

8. Are there any particular experiences or factors that you feel has shaped your opinion of neurology?
9. Has your opinion of neurology changed over time?
10. Are there any particular areas you struggle with in neurology?
11. Please tell me about your experiences learning neurology.

Comparison of neurology to other disciplines

12. How do you feel your knowledge of neurology compares to your knowledge of other disciplines?
13. How do you feel your ability to deal with neurological cases compares to your ability to deal with cases of other disciplines?

14. Please think about a(nother) discipline that you enjoy or are comfortable with. Why do you feel that way about it?

Additional information/perspectives

15. Are there any comments you wish to make about neurology, your views on it, other people's views, reasons for people's perceptions, etc.?

Confirmation of participant's self-grouping

In your initial response regarding participation in this study, you identified as having/being: (*unselected alternatives will be deleted*)

1) Overall, a negative opinion of neurology and would choose to avoid dealing with neurological cases if possible/if an alternative option is available
2) some negative perceptions of neurology, but don't allow this to completely put me off neurological cases
3) an overall neutral/indifferent attitude towards neurology
4) enthusiastic about neurological cases and enjoy neurology

Can you please elaborate on the reason(s) you selected this category?

24-item Frost Multidimensional Perfectionism Scale (FMPS-24)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Questions relating to the subscale Concern over Mistakes and Doubts about Actions (CMDA)					
If I fail at work/school, I am a failure as a person	1	2	3	4	5
I should be upset If I make a mistake.	1	2	3	4	5
If someone does a task better at work/school better than I, then I feel like I failed the whole task.	1	2	3	4	5
People will probably think less of me if I make a mistake.	1	2	3	4	5
If I do not do as well as people, it means I am an inferior human being.	1	2	3	4	5
If I do not do well all the time, people will not respect me.	1	2	3	4	5
I usually have doubts about the simple everyday things I do.	1	2	3	4	5
I tend to get behind my work because I repeat things over and over.	1	2	3	4	5
It takes me a long time to do something ''right''.	1	2	3	4	5
The fewer mistakes I make, the more people will like me.	1	2	3	4	5
Questions relating to the subscale Parental Expectations and Parental Criticisms (PEPC)					
My parents set very high standards for me.	1	2	3	4	5
As a child I was punished for doing things less than perfect.	1	2	3	4	5
My parents wanted me to be the best at everything.	1	2	3	4	5
Only outstanding performance is good enough in my family.	1	2	3	4	5
My parents have always had higher expectations for my future than I have.	1	2	3	4	5
I never felt like I could meet my parents' expectations.	1	2	3	4	5
Questions relating to the subscale Organisation (ORG)*					
I am a neat person.	1	2	3	4	5
I try to be an organized person.	1	2	3	4	5
I try to be a neat person.	1	2	3	4	5
Neatness is very important to me.	1	2	3	4	5
Questions relating to the subscale Personal Standards (PS)					
I am very good at focusing my efforts at attaining a goal.	1	2	3	4	5
I have extremely high goals.	1	2	3	4	5
Other people seem to accept lower standards from themselves that I do.	1	2	3	4	5
I expect higher performance in my daily tasks than most people.	1	2	3	4	5

*Items relating to the subscale Organisation are not included in the total perfectionism score.

Rationale for adjustments made to the mindset scale

Armitage-Chan and Maddison (2019) used an adapted version of Dweck et al.'s (1995) Implicit Theories of Intelligence Scale to evaluate differences in veterinary students' mindset towards different aspects of the undergraduate curriculum. Their study identified variability in the proportion of students expressing a growth mindset between clinical reasoning, professional reasoning, communication skills and reflection.

To evaluate mindset towards neurology, I chose to adapt the most relevant section of Armitage-Chan and Maddison's (2019) scale, i.e. the questions evaluating mindset towards clinical reasoning. Wording was altered to focus the respondent on neurology and neurological cases, because of the potential influences of context on mindset. The wording changes are outlined below in Table A.2.

In these mindset questions, respondents are asked to indicate their agreement with a series of statements, using a Likert scale. The type of Likert scale used differs in different adaptations of Dweck et al.'s (1995) Implicit Theories of Intelligence Scale, with the original version using a 6-point scale and versions like that of Armitage-Chan and Maddison (2019) using a 4-point scale. Rather than using a 4-point Likert scale, I chose to offer respondents a neutral option: Neither agree nor disagree. Providing a neutral option was intended to reduce time spent answering the questions (the respondent was not forced to choose between answers they did not fully agree with). This was important as the survey was long and already risked survey fatigue. However, it prevented application of previously used cut-off values for determination of fixed or growth mindset (Armitage-Chan & Maddison, 2019; Atwood, 2010). Results were therefore presented according to the statement, "higher scores in the mindset scale indicate more of a growth mindset, while lower scores indicate more of a fixed mindset". The mindset questions used in my study were intended to evaluate whether further evaluation of the influence of mindset on perspectives of disciplines such as neurology is indicated rather than make absolute statements regarding fixed or growth mindset.

The final 5-point scale ranged from 0 (Strongly agree) to 4 (Strongly disagree).

Table A.2 Comparison of the wording of the original mindset questions and the questions adapted to focus on the discipline of neurology.

Original Question	Question after adaptation to focus the respondent on neurology
In clinical scenario sessions the most important information to learn is the end diagnosis.	As a student learning neurology, when working through clinical scenario sessions the most important information to learn is the end diagnosis.
In clinical scenarios I value the opportunity to practice the problem-solving process.	When working through neurological cases I value the opportunity to practice the problem-solving process.
If I learn a logical approach to clinical problem solving I am confident I will be able to reach a diagnosis in my patients.	If I learn a logical approach to clinical problem-solving, I am confident I will be able to reach a diagnosis in my neurological patients.
I find it frustrating to learn a problem-solving approach and prefer to learn the diagnoses.	I find it frustrating to learn a problem-solving approach and prefer to learn the diagnoses.
I find it unhelpful to receive feedback on the problem-solving process, what is needed is the diagnosis.	When working through cases, I find it unhelpful to receive feedback on the problem-solving process - what is needed is the diagnosis.

Rationale for adjustments made to the Intolerance of Uncertainty Scale

As discussed in Chapter 5, intolerance of uncertainty has been defined as "an excessive tendency to find uncertain situations stressful and upsetting, to believe that unexpected events are negative and should be avoided, and to think that being uncertain about the future is unfair" (Dugas et al., 2005, p. 58). Intolerance of ambiguity is a similar concept, with cognitive, emotional and behavioural reactions to ambiguous situations (Grenier et al., 2005). Tolerance of uncertainty or ambiguity is typically evaluated using a generic scale, although some scales have been developed for a specific population (for example, evaluation of ambiguity in veterinary students as per Hammond (2018).

In this study, I chose to evaluate intolerance of uncertainty rather than intolerance of ambiguity. Although both concepts are associated with similar cognitive and emotional responses, intolerance of ambiguity refers to a static situation occurring in the present, while intolerance of uncertainty refers to a future event (Grenier et al., 2005). In the qualitative interview study in my research, multiple participants spoke of *expectations* of uncertainty, suggesting a focus on the future. Participants' worry over the *potential* to make mistakes also suggested uncertainty concerns were focused on future more than current events.

An individual's tolerance of ambiguity was reported to be relatively stable over sequential years in a cohort of veterinary students (Hammond, 2018). However, several participants in that study did show notable variation in their tolerance scores between years. Variation was most common amongst individuals with a moderate tolerance of ambiguity, with the tendency to become less, not more, tolerant of ambiguity. As noted in Chapter 5. serial variation in intolerance of uncertainty has also been reported (Carnahan et al., 2022; Shapiro et al., 2020).

The differences in wording between the Intolerance of Uncertainty Scale questions and the questions used in my questionnaire are outlined below in Table A.3.

Table A.3 Comparison of the wording of original Intolerance of Uncertainty Scale questions and the questions adapted to focus on the discipline of neurology.

Original Question	Question after adaptation to focus the respondent on neurology
Uncertainty stops me from having a strong opinion.	Uncertainty when dealing with neurological cases stops me from having a strong opinion.
Being uncertain means that a person is disorganised.	Being uncertain makes me feel disorganised.
Uncertainty makes life intolerable.	Uncertainty makes neurological cases intolerable.
It's unfair that there are no guarantees in life.	It's unfair that there are no guarantees in neurological cases.
My mind can't relax if I don't know what will happen tomorrow.	My mind can't relax if I don't know what is happening with my case.
Uncertainty makes me uneasy, anxious, or stressed.	Uncertainty makes me uneasy, anxious, or stressed.
Unforeseen events upset me greatly.	Unforeseen events upset me greatly.
It frustrates me if I don't have all the information I need.	It frustrates me if I don't have all the information I need.
Uncertainty keeps me from living a full life.	Uncertainty keeps me from enjoying neurological cases/neurology.
One should always look ahead so as to avoid surprises.	One should always look ahead so as to avoid surprises.
A small unforeseen event can spoil everything, even with the best planning.	A small unforeseen event can spoil everything, even with the best planning.
When it's time to act, uncertainty paralyses me.	When it's time to act with a neurological case, uncertainty paralyses me.
Being uncertain means that I am not first rate.	Being uncertain means that I am not doing a good job.
When I am uncertain, I can't go forward.	When I am uncertain, I can't go forward.
When I'm uncertain, I can't function very well.	When I'm uncertain, I can't function very well.
Unlike me, others seem to know where they are going with their lives.	Others seem to know how to manage neurological cases better than I do.
Uncertainty makes me feel vulnerable, unhappy, or sad.	Uncertainty makes me feel vulnerable, unhappy, or sad.
I always want to know what the future has in store for me.	I always want to know what the answer/prognosis is.
I can't stand being taken by surprise.	I can't stand being taken by surprise.
The smallest doubt can stop me acting.	The smallest doubt can stop me acting.
I should be able to organise everything in advance.	I should be able to organise everything for my cases in advance.
Being uncertain means that I lack confidence.	Being uncertain means that I lack confidence with neurological cases.
I think it's unfair that other people seem to be sure about their future.	I think it's unfair that other people seem to be more sure how to manage neurological cases.
Uncertainty keeps me from sleeping soundly.	Uncertainty about my cases keeps me from sleeping soundly.
I must get away from all uncertain conditions.	I must get away from all uncertain conditions.
The ambiguities in life stress me.	The ambiguities in neurological cases stress me.
I can't stand being undecided about my future.	I can't stand being undecided about how to manage neurological cases.

Survey of veterinarians' perspectives of neurology

Section 1: Questions regarding demographic information

First, we would like to know some general information about you and your veterinary background.

1. What area(s) of the veterinary sector have you/do you currently work in? (Tick all that apply)

Companion animal	Exotics	Referral practice	Research sector
Equine	Aquaculture	Academia	Other (please elaborate)
Production animal	General practice	Laboratory-based	

2. Which gender do you identify with?

Male	Female	Another gender	I'd rather not say

3. In which country did you obtain your undergraduate veterinary degree?

Australia	New Zealand	United Kingdom	Other (please elaborate)

4. In what year did you finish your veterinary degree? [open text field]

5. Since obtaining your veterinary degree, in which countries/regions have you worked in clinical practice? Please state all that apply.

I have never worked in clinical practice

Australia	New Zealand	United Kingdom	North America
Ireland	Africa	Middle East	South America
Europe	Asia	Other (please list the countries/regions)	

6. In your experience, how easy is/has it been for YOU to refer a case to a veterinary neurology specialist?

Very easy	There has never been a veterinary neurology specialist I could refer cases to
Easy	I have never needed to refer a case to a veterinary neurology specialist
Not very easy	

7. In your experience, how common is pet insurance amongst your clients?

Very common	Not very common
Common	I don't have any clients with pet insurance

8. Since obtaining your veterinary degree, have you completed at least one year of an internship or residency in which you frequently interacted with a neurology service?

Yes	No

9. Since obtaining your veterinary degree, have you undertaken a short (less than one year) post-graduate course in neurology?

Yes	No

10. If you wish to elaborate further on these postgraduate courses of study, please do so here.

Section 2: Questions relating to how neurology compared to other disciplines

At present, we don't know how veterinarians feel about neurology or neurological cases, or whether this is different to how veterinarians feel about other disciplines. The following questions will help us understand how veterinarians' perspectives of neurology compare to that of other disciplines.

11. Overall, how do you feel when you are presented with a neurological case?

I am enthusiastic about neurological cases and enjoy neurology.

I have an overall neutral/indifferent perspective of neurology.

I have some negative perceptions of neurology, but don't allow this to completely put me off neurological cases.

Overall, I have a negative opinion of neurology and if the option to refer or have a colleague manage the case is available, I would choose it every time.

I have no experience managing neurological cases.

12. Which of these disciplines do you enjoy the most? (You may select only one.)

Anaesthesia	Diagnostic Imaging	Nutrition	Parasitology
Cardiology	Emergency and critical care	Oncology	Reproduction
Dentistry	Endocrinology	Ophthalmology	Soft tissue surgery
Dermatology	Internal medicine (other)	Orthopaedics	

13. Which of these disciplines do you enjoy the least?

Anaesthesia	Diagnostic Imaging	Nutrition	Parasitology
Cardiology	Emergency and critical care	Oncology	Reproduction
Dentistry	Endocrinology	Ophthalmology	Soft tissue surgery
Dermatology	Internal medicine (other)	Orthopaedics	

14. Please choose the THREE statements that best explain why you enjoy [selected discipline] the most.

I am comfortable recognising and/or interpreting clinical presentations.

I know how to approach these cases.

I feel in control when dealing with these cases.

These conditions are usually mild.

I can make a positive difference.

I can easily access diagnostic investigations.

I can "see"/find answers in diagnostic investigations.

I usually get a definitive diagnosis.

Costs are low.

Outcomes justify the costs.

These conditions are easy to treat.

I frequently see these conditions.

Outcomes are typically good.

Most conditions can be cured.

These conditions are emotionally easy.

I often feel I have done a good job.

I often feel I have helped the client and/or patient.

It is not stressful.

Cases are fascinating.

Cases are challenging.

Other (please elaborate)

15. Please choose the THREE statements that best explain why you enjoy [selected discipline] the least.

I am not comfortable recognising and/or interpreting clinical presentations.
I don't know how to approach these cases.
I don't feel in control when dealing with these cases.
These conditions are often severe.
These conditions are often life-altering.
I can't make a positive difference.
I can't easily access diagnostic investigations.
I can't "see"/find answers in diagnostic investigations.
I usually don't get a definitive diagnosis.
I am usually hampered by costs.
Outcomes do not justify the costs.
These conditions are difficult to treat.
I frequently see these conditions.
Outcomes are typically poor.
Most conditions cannot be cured.
It has little relevance to my work day.
These conditions are emotionally difficult.
I often feel I have not done a good job.
I often feel unable to do as much as I should.
I often feel I am letting the client and/or patient down.
I get stressed.
Cases are boring.
I hardly ever see these conditions.
Other (please elaborate)

16. *The question below was repeated for each statement used to explain why the respondent enjoyed the discipline they chose.*

You said that you enjoy [chosen discipline] because '[chosen reason]'. Compared to [chosen discipline], how does this statement apply to NEUROLOGY?

It applies more to Neurology than it does to [chosen discipline]
It applies to Neurology to the same degree as it applies to [chosen discipline]
It applies less to Neurology than it does to [chosen discipline]
It does not apply to Neurology

17. *The question below was repeated for each statement used to explain why the respondent did not enjoy the discipline they chose.*

You said that you do not enjoy [chosen discipline] because '[chosen reason]'. Compared to [chosen discipline], how does this statement apply to NEUROLOGY?

It applies more to Neurology than it does to [chosen discipline]
It applies to Neurology to the same degree as it applies to [chosen discipline]
It applies less to Neurology than it does to [chosen discipline]
It does not apply to Neurology

18. If you wish, please explain how/why neurology is similar or different to disciplines you like most or disciplines you like least.

19. Different people find different aspects of case management emotionally difficult. Please indicate on the sliding scale how emotionally difficult you find the following, when dealing with **neurological** cases.

(Scale:0 = Not at all emotionally difficult to 10 = Extremely emotionally difficult)

Limitations in my ability to make a plan (e.g. time pressure, knowing where to start)
Limitations in my understanding of neurological cases
Limitations in my ability to get a definitive answer

Limitations in my ability to make a positive difference

External limitations (e.g. financial, access to diagnostics, owner unwillingness)

Section 3: Questions relating to perspectives of neurology

The following questions relate to your experiences with neurological cases and your opinions of these experiences. These questions are intended to help understand factors that may have contributed to the development of your perspective of neurology.

20. Please indicate your agreement with the following statements regarding neurological cases and learning neurology.

(Strongly agree, somewhat agree, neither agree nor disagree, somewhat agree, strongly disagree)

As a student learning neurology, when working through clinical scenario sessions the most important information to learn is the end diagnosis.

When working through neurological cases I value the opportunity to practice the problem-solving process.

If I learn a logical approach to clinical problem-solving I am confident I will be able to reach a diagnosis in my neurological patients.

I find it frustrating to learn a problem-solving approach and prefer to learn the diagnoses.

When working through cases, I find it unhelpful to receive feedback on the problem-solving process - what is needed is the diagnosis.

21. Which of the following best describes how frequently you see neurological cases?

One or more per day	One or more per month	One or two a year
One or more per week	One every few months	Less than one a year

22. If you would like to provide further detail, please do so here.

23. How often do you feel positive (in general) about a neurological case?

Always or almost always	Most of the time	Sometimes	Never or hardly ever

24. How often are you happy with your evaluation and understanding of a neurological case?

Always or almost always	Most of the time	Sometimes	Never or hardly ever

25. How often do you feel positively about the outcome of a neurological case?

Always or almost always	Most of the time	Sometimes	Never or hardly ever

26. Regarding neurological cases in general, how much do you agree with the following statements? [Agree, Neither agree nor disagree, Disagree]

Prior to seeing a neurological case, I expect it will be difficult (intellectually or emotionally)

After seeing the case, it often doesn't seem as bad as I expected

I think most vets don't like neurology

27. If you would like to make any comments regarding your answers to these questions, please do so here.

28. What do you enjoy the most about neurology/neurological cases? (You may only select one.)

There is nothing that I enjoy about neurological cases

I can make sense of my examination findings

Neurology is logical

I can problem-solve or use reasoning to find answers

I enjoy the diagnostic approach

I enjoy the treatment or management

I can make a positive difference to quality of life for my neurological patients

I can make a positive difference to quality of life for owners of neurological patients

I can learn from the case

I enjoy the challenge

Neurological cases are interesting

Neurological cases are easy to manage

I feel good about myself when neurological cases go well

I like being viewed as intelligent or respected by others when I manage neurological cases

Other (please elaborate)

29. Is there anything else you enjoy about neurology/neurological cases? (Please select all that apply)

There is nothing else that I enjoy about neurological cases

I can make sense of my examination findings

Neurology is logical

I can problem-solve or use reasoning to find answers

I enjoy the diagnostic approach

I enjoy the treatment or management

I can make a positive difference to quality of life for my neurological patients

I can make a positive difference to quality of life for owners of neurological patients

I can learn from the case

I enjoy the challenge

Neurological cases are interesting

Neurological cases are easy to manage

I feel good about myself when neurological cases go well

I like being viewed as intelligent or respected by others when I manage neurological cases

Other (please elaborate)

30. If there is anything else you would like us to know about why/what you enjoy about neurology or neurological cases, please let us know here.

31. What do you find **easiest** when managing neurological cases? (You may only select one.)

I don't find anything easy

Performing the neurological examination

Interpreting the neurological examination

Creating a differential diagnoses list

Explaining the problem(s) to most owners

Performing diagnostic investigations

Devising a treatment plan

Managing most clients' expectations

Maintaining a good relationship with most clients

Managing my own expectations of myself and/or my abilities

Other (please elaborate)

32. Is there any other aspect of managing neurological cases you find easy? (Please select all that apply.)

I don't find anything else easy

Performing the neurological examination

Interpreting the neurological examination

Creating a differential diagnoses list

Explaining the problem(s) to most owners

Performing diagnostic investigations

Devising a treatment plan

Managing most clients' expectations

Maintaining a good relationship with most clients

Managing my own expectations of myself and/or my abilities

Other (please elaborate)

33. If you would like to make any comments regarding how easy – or how difficult – you find any aspects of neurological cases, please do so here.

34. What do you feel is the greatest difficulty you face when managing neurological cases? (You may only select one.)

I don't find anything difficult

I don't have a good approach to dealing with them/I don't know where to start

I don't have enough support

I haven't had enough experience with neurological cases

I don't understand the "basics" of neurology

I don't know enough about neurology (even if I understand the "basics")

I worry I will miss something important or make mistakes

I have had bad experiences in the past and I worry the same thing(s) will happen

There is so much uncertainty with neurological cases

There are so many barriers to getting an answer (e.g. access to diagnostics, cost, owner willingness)

I can't physically see what I'm dealing with

Neurological diseases have a big effect on the animal's and/or owner's quality of life

I feel the weight of the owner's expectations

I feel there is little I can do to help

I often don't have enough time to think before I need to act

I feel like I am not doing a good job when I have a neurological case

Neurological cases make me feel like I am not a good vet

Other (please elaborate)

35. Do you also have difficulty with any of the following with regards to neurological cases? (Please select all that apply.)

I don't find anything else difficult

I don't have a good approach to dealing with them/I don't know where to start

I don't have enough support

I haven't had enough experience with neurological cases

I don't understand the "basics" of neurology

I don't know enough about neurology (even if I understand the "basics")

I worry I will miss something important or make mistakes

I have had bad experiences in the past and I worry the same thing(s) will happen

There is so much uncertainty with neurological cases

There are so many barriers to getting an answer (e.g. access to diagnostics, cost, owner willingness)

I can't physically see what I'm dealing with

Neurological diseases have a big effect on the animal's and/or owner's quality of life

I feel the weight of the owner's expectations

I feel there is little I can do to help

I often don't have enough time to think before I need to act

I feel like I am not doing a good job when I have a neurological case

Neurological cases make me feel like I am not a good vet

Other (please elaborate)

36. If you would like to comment further on the difficulties you face when dealing with neurological cases, please do so here.

37. What best describes your <u>undergraduate</u> experiences of neurology-based subjects:

Positive | Neutral | Negative | I'm not sure

38. What best describes your experiences of neurology-based subjects <u>after graduation</u>:

Positive | Neutral | Negative | I'm not sure

39. What has had the **most** influence on your opinion of neurology/neurological cases? (You may only select one.)

My undergraduate experience(s) of neurology-based subjects

Experiences of veterinary neurology since I graduated

Support from colleagues/specialists

Comments made by others regarding my performance with neurological cases

Experiences in my personal life

Other (please elaborate)

Section 4: Questions relating to aspects of veterinary practice that are important to the respondent

The following questions aim to explore what is important to you as a veterinarian. We all have slightly different views on what the role, function or 'professional identity' of a veterinarian is. Those views can affect how we feel when we are able to - or not able to - fulfil what we see as our function or role. The following questions do not relate to any specific discipline.

40. Which of the following do you feel BEST defines the role or requirements of a veterinarian? (You may choose up to THREE statements.)

Providing skilled animal care

Doing everything possible to obtain the optimum patient outcome

Providing a solution for any animal health issue

Communicating knowledge to owners so they can make choices

Guiding owners to make the right choice for their animal

Problem-solving to provide answers to owners

Progression of the veterinary profession through experiential and/or scientific learning

Prioritising client/owner needs, even if life-ending for the animal(s)

Prioritising animal welfare/life, even when at odds with client/owner wishes

Being able to admit our own limitations in knowledge and/or ability

Continuous learning and professional development to improve animal care

Engaging in reflective practice to improve our future performance

Educating clients about ways to improve animal care

Providing emotional support and/or empathy for clients

Providing support for colleagues (emotional, practical, or intellectual)

Other (please elaborate)

41. What would be most likely to make you feel you have been 'successful' with a case (of any type or discipline)? (You may only select one.)

The patient being able to go home

'Fixing' the problem

Finding an answer for the problem

Helping the patient – even if that is life-ending

Having the owner feel satisfied with my performance

Learning from the case (whatever its outcome)

Feeling I had personally made a difference

Other (please elaborate)

42. If you would like to elaborate on what makes you feel successful with veterinary cases, please do so here.

43. What do you find most difficult when dealing with clinical veterinary cases (of any type or discipline)?

Balancing external limitations with provision of optimum patient care (e.g. financial constraints, owner willingness to follow recommendations, access to equipment or treatments, ability to examine animals)

Meeting client expectations

Time pressures preventing me completing all tasks to a standard with which I am happy

Meeting my expectations of myself

Managing the emotional burden placed on me by clients or through bonds with my patients

Feeling that I am not good/knowledgeable enough

Not having someone available to provide me with sufficient support (emotional, practical or knowledge) when I need it

Dealing with uncertainty when I don't find an answer to explain the clinical problem

Other (please elaborate)

44. If you would like to elaborate on the aspects of veterinary cases that you find difficult, please do so here.

45. Drag and drop the following statements to rank their relative importance when you are managing a clinical case of any type or discipline, from most important (rank 1) to least important (rank 10).

Getting a definitive diagnosis

Being able to cure the condition

Achieving results quickly (e.g. examination findings, getting answers, treatment response)

Keeping costs low

Being able to explain the problem to the owner

Appearing to know what I am talking about

Not needing to spend time researching the problem later in the day

Meeting the needs of the owner

Meeting the needs of the patient

Feeling in control/having a plan

Sections 5 and 6: Measures of perfectionism and tolerance of uncertainty

As veterinarians we are expected to uphold certain standards and are often placed under pressure to meet these expectations by others and/or ourselves. The following questions are intended to evaluate factors that may affect how others'/your own expectations influence your approach to a task.

46. **Perfectionism scale - see Appendix B for the scale.** You will find below a series of statements which describe how people may approach a task or personally view their work ethic. Please use the scale below to describe to what extent you agree with each statement (for each item please tick one of the five boxes).

47. **Intolerance of Uncertainty scale - see Appendix B for the scale.** You will find below a series of statements which describe how people may react when faced with the need to manage a neurological case. Please use the scale below to describe to what extent each item is characteristic of you.

48. Please indicate your agreement with the following statement. (Sliding scale 0 = Strongly disagree to 10 = Strongly agree)

    I feel more uncertain about neurology and neurological cases than I do about most other disciplines.

49. Please select all the statements that apply to the ending of the following sentence.
    "When treating neurological cases, uncertainty…"

doesn't really bother me.	makes me anxious.	makes me frustrated.	makes me feel helpless.
makes me uncomfortable.	makes me stressed.	makes me doubt myself.	Other (please elaborate)

50. Please indicate your agreement with the following statements. (Sliding scale 0 = Strongly disagree to 10 = Strongly agree)

    I am comfortable dealing with uncertainty when I am working.

    I am comfortable dealing with uncertainty in my personal life.

    I struggle with uncertainty more when the stakes are higher.

51. This is the final question. If there are any other comments you would like to make regarding your views on neurology/neurological cases, the reasons behind your views, or whether there is anything that you feel might help improve your view of neurology, please let me know here. [open text]

Survey of veterinary students' perspectives of neurology.

Section 1: Questions regarding demographic information

Firstly, we would like to know some general information about you.

1. What year of the veterinary science program are you currently in?

1st year	2nd year	3rd year
5th year		

2. What is your age?

<20 years old	21-30 years old	>30 years old	Prefer not to say

3. Which gender do you identify with?

Male	Female	Another gender	I prefer not to say

4. Which veterinary sector are you planning to enter?

Production animal	Equine	Non-clinical (e.g., public health, pathology, MPI)
Small animal	Exotics and/or wildlife	Other (please elaborate)
Mixed practice	I don't know yet	I don't think I will work in the veterinary profession

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Section 2: Perspectives of Neurology

We would like to know how veterinary students feel about neurology or neurological cases, and whether this is different to how you feel about other disciplines. The following questions aim to explore your opinions of different subjects. Firstly, I would like to know **how you feel about neurology-based subjects**.

5. What is your overall view of neurology-based subjects (e.g. neuroanatomy, neurophysiology, and clinical neurology)?

   I am enthusiastic about neurology and enjoy neurology-based subjects

   I have an overall neutral or indifferent perspective of neurology-based subjects

   I have some negative perceptions of neurology, but don't allow this to completely put me off neurology-based subjects

   Overall, I have a negative opinion of neurology and would prefer not to have to learn neurology-based subjects

   I haven't formed an opinion about neurology yet

6. Which **<u>ONE</u>** of the following words or phrases **<u>best</u>** describes neurology-based subjects (e.g. neuroanatomy, neurophysiology, clinical neurology)? If you have not studied neurology-based subjects, please answer based on your expectations or general perceptions of these subjects.

Interesting	Satisfying	Challenging (in a good way)
Logical	Motivating	High relevance to my career choice
Prestigious	Clinically rewarding	More enjoyable than I expected
Overly detailed	Difficult to understand	Much is unknown, even in people
Overwhelming	Dissatisfying	Low relevance to my career choice
Demotivating	Hard to remember	Only for the very intelligent
Clinically severe	Un-fixable	Sad
Stressful	Scary	High-risk
Other (please elaborate)		I have no opinion of neurology

7. Do any other words or phrases describe your feelings towards neurology-based subjects (e.g. neuroanatomy, neurophysiology, clinical neurology)? (**Please select all that apply**.)

Interesting	Satisfying	Challenging (in a good way)
Logical	Motivating	High relevance to my career choice
Prestigious	Clinically rewarding	More enjoyable than I expected
Overly detailed	Difficult to understand	Much is unknown, even in people
Overwhelming	Dissatisfying	Low relevance to my career choice
Demotivating	Hard to remember	Only for the very intelligent
Clinically severe	Un-fixable	Sad
Stressful	Scary	High-risk
Other (please elaborate)		I have no other opinions of neurology

8. If you would like to elaborate on your answers, please do so here.

9. Do you have any experience of neurological disease or dealing with neurological cases (human or veterinary)?

   Yes, I have experience of neurological disease in an animal(s)

   Yes, I have experience of neurological disease in a human(s)

   Yes, I have experience of neurological disease in both a human(s) and an animal(s)

   No

   I prefer not to answer

Our experiences can affect our perspectives. We would like to know how your experiences affected your perspectives of neurology and neurology-based subjects.

10. What stood out to you **most** regarding this experience? (You may only select one.)

    I found the neurological facets interesting

    It helped me understand neurology and/or neurological disease

    I was motivated to learn more about neurology

    I found the situation emotionally rewarding

    I was confused by the situation

    I was frustrated by the situation

    I found the situation stressful

    I found the situation emotionally difficult

    Other (please elaborate)

11. Did this experience affect your view of neurological disease(s)?

Yes	Maybe – I don't know	No	I prefer not to say

12. How did this experience affect your view of neurological disease(s)? (**Please select all that apply.**)

    It made me more interested in neurological disease

    It made me wish to understand neurological disease better

    It showed we can make positive differences to the lives of those with neurological disease

    It showed we can improve or cure neurological diseases

    It put me off learning more about neurology

    It showed me neurological diseases are unfair

It showed me neurological diseases are life-altering

It showed me little can be done for neurological diseases

Other (please elaborate)

I prefer not to say

13. Do you think your experience helped you understand how a neurological lesion can produce certain clinical signs?

    Yes Maybe – I don't know No I prefer not to say

14. If you wish to provide further information regarding your feelings about the experience, please do so here. [open text]

Section 3: How neurology compared to other disciplines

In the veterinary curriculum, neurology is taught in different years of study as neuroanatomy, neurophysiology, neuropharmacology, and clinical neurology. Prior to entering the BVSc programme you may also have studied neurology in another course. These questions relate to how you have **learned** different subjects, including neurology.

15. At ANY point in your academic or school experience, can you recall learning or being taught neurology-based subjects?

    I can recall learning or being taught neurology-based subjects

    I have no experience of, or cannot recall, learning or being taught any neurology-based subjects

16. Which category of subjects or disciplines do you **enjoy the <u>most</u>**? (This may be from any year of your study. You may only select one category.)

    Basic sciences (e.g. Anatomy, Physiology, Biochemistry, Microbiology)

    Professional practice (e.g. Animal Welfare and Ethics, Veterinary Public Health, Communication)

    Pathology (e.g. Histology, Clinical Pathology)

    Cross-species disciplines (e.g. Infectious disease, Pharmacology, Imaging, Nutrition)

    Clinical specialties (e.g. Reproduction, Surgery, Ophthalmology)

    Other (please elaborate)

17. Which category of subjects or disciplines do you **enjoy the <u>least</u>**? (This may be from any year of your study. You may only select one category.)

    Basic sciences (e.g. Anatomy, Physiology, Biochemistry, Microbiology)

    Professional practice (e.g. Animal Welfare and Ethics, Veterinary Public Health, Communication)

    Pathology (e.g. Histology, Clinical Pathology)

    Cross-species disciplines (e.g. Infectious disease, Pharmacology, Imaging, Nutrition)

    Clinical specialties (e.g. Reproduction, Surgery, Ophthalmology)

    Other (please elaborate)

18. If you wish to be more specific regarding the subjects or disciplines you enjoy the most or the least, please provide additional information here.

19. You indicated that the subject or disciplines you **enjoyed the most** is category '[insert category name]'.

Please choose up to THREE reasons that **best explain** why you enjoy these subjects or disciplines **more** than others?

I find them easy to learn or remember

I get good grades in these subjects

I understand them

I like how challenging they are

I find them fascinating

I have previous experience of these subjects (personal, academic, or professional)

The lecturers make the subjects interesting and/or enjoyable

The lecturers make the subjects easy to understand

They are relevant to my planned career

I can visualise or see the concepts that I am learning

The workload is appropriate

I know which parts are important to learn

They make me feel like I am making progress to becoming a vet

They make me feel good about myself and/or my abilities

I feel confident in my performance in the subjects

Other (please elaborate)

20. You indicated that the subject or disciplines you **enjoyed the least** is category '[insert category name]'.

Please choose up to THREE reasons that best explain why you enjoy these subjects or disciplines **less** than others?

I find them difficult to learn or remember

I get worse grades in these subjects

I have difficulty understanding them

I do not like how challenging they are

I find them boring

I have previous experience of these subjects (personal, academic, or professional)

The lecturers make the subjects uninteresting and/or unenjoyable

The lecturers make the subjects harder to understand

They are not relevant to my planned career

I cannot visualise or see the concepts that I am learning

The workload is too high

I do not know which parts are important to learn

They do not make me feel like a "real vet"

They make me feel bad about myself and/or my abilities

I am not confident in my ability to do well in the subjects

Other (please elaborate)

21. You indicated that the subjects or disciplines you enjoy the **most** are in the category '[chosen category]'.

You provided the following statements as reasons why you enjoy this category of subjects or disciplines. For each, please indicate how well the statement applies to NEUROLOGY-BASED SUBJECTS compared to the subjects or disciplines you enjoy in the category '[chosen category]'.

The question below was repeated for each statement used to explain why the respondent enjoyed the discipline they chose.

How does the statement 'xx' apply to NEUROLOGY-BASED SUBJECTS (e.g. neuroanatomy, neurophysiology, and clinical neurology)?

- It applies more to Neurology-based subjects than it does to subjects or disciplines I enjoy
- It applies to Neurology-based subjects to the same degree as it applies to subjects or disciplines I enjoy
- It applies less to Neurology-based subjects than it does to subjects or disciplines I enjoy
- It does not apply to Neurology-based subjects
- I am not sure

22. You indicated that the subjects or disciplines you enjoy the **least** are in the category '[chosen category]'.

You provided the following statements as reasons why you enjoy this category of subjects or disciplines the least. For each statement, please indicate how well the statement applies to NEUROLOGY-BASED SUBJECTS compared to the subjects or disciplines you enjoy in the category '[chosen category]'.

The question below was repeated for each statement used to explain why the respondent did not enjoy the discipline they chose.

How does the statement 'xx' apply to NEUROLOGY-BASED SUBJECTS (e.g. neuroanatomy, neurophysiology, and clinical neurology)?

- It applies more to Neurology-based subjects than it does to subjects or disciplines I enjoy
- It applies to Neurology-based subjects to the same degree as it applies to subjects or disciplines I enjoy
- It applies less to Neurology-based subjects than it does to subjects or disciplines I enjoy
- It does not apply to Neurology-based subjects
- I am not sure

Section 4: Experiences learning neurology

We all approach learning and studying in a slightly different way. The following questions are intended to help understand the way(s) you approach learning and your experiences **learning** different subjects.

23. You stated you enjoy [enjoyed subject category answer]. Please select the THREE statements that **best** describe your **approach to or experience of learning subjects you enjoy** in this category.

- At times, studying gave me a feeling of deep personal satisfaction.
- I worked hard at my studies because I found the material interesting.
- I only seriously studied what was given out in class or in the course outlines.
- I came to most classes with questions that I wanted answering.
- I tested myself on important topics until I understood them completely.
- I learnt some things by rote - memorising them, even if I did not understand them.
- I spent a lot of my free time finding out more about interesting topics discussed in lectures.
- I made a point of looking at most of the suggested readings that went with the lectures.
- I generally restricted my study to what was specifically set - it is unnecessary to do extra.
- I could get by in most assessments by memorising key sections rather than trying to understand them.
- I didn't find it useful to study in depth - it was confusing and wasted time when you only need to know enough to pass.

I didn't see the point in learning material which was not likely to be in the examination.

I didn't have enough time to learn this subject

I didn't make an effort to learn/study the subject

Other (please elaborate)

24. You stated that you do not really enjoy [least enjoyed subject category answer].

Please select the THREE statements that best describe **your approach to or experience of <u>learning</u>** subjects you do not enjoy.

At times, studying gave me a feeling of deep personal satisfaction.

I worked hard at my studies because I found the material interesting.

I only seriously studied what was given out in class or in the course outlines.

I came to most classes with questions that I wanted answering.

I tested myself on important topics until I understood them completely.

I learnt some things by rote - memorising them, even if I did not understand them.

I spent a lot of my free time finding out more about interesting topics discussed in lectures.

I made a point of looking at most of the suggested readings that went with the lectures.

I generally restricted my study to what was specifically set - it is unnecessary to do extra.

I could get by in most assessments by memorising key sections rather than trying to understand them.

I didn't find it useful to study in depth - it was confusing and wasted time when you only need to know enough to pass.

I didn't see the point in learning material which was not likely to be in the examination.

I didn't have enough time to learn this subject

I didn't make an effort to learn/study the subject

Other (please elaborate)

25. You stated you enjoy '[chosen category]'. For each of the following statements, please indicate how well the statement applies to NEUROLOGY-BASED SUBJECTS compared to **<u>learning</u>** the subjects or disciplines you enjoy in the category '[chosen category]'.

The question below was repeated for each statement used to explain why the respondent enjoyed the discipline they chose.

How does the statement 'xx' apply to **<u>learning</u>** NEUROLOGY-BASED SUBJECTS (e.g. neuroanatomy, neurophysiology, and clinical neurology)?

It applies more to Neurology-based subjects than it does to learning subjects or disciplines I enjoy

It applies to Neurology-based subjects to the same degree as it applies to learning subjects or disciplines I enjoy

It applies less to Neurology-based subjects than it does to learning subjects or disciplines I enjoy

It does not apply to Neurology-based subjects

I am not sure

26. You stated you enjoy '[chosen category]' less than other categories. For each statement, please indicate how well the statement applies to NEUROLOGY-BASED SUBJECTS (e.g. neuroanatomy, neurophysiology, and clinical neurology) compared to the subjects or disciplines you enjoy **<u>least</u>** in the category '[chosen category]'.

The question below was repeated for each statement used to explain why the respondent did not enjoy the discipline they chose.

How does the statement 'xx' apply to **learning** NEUROLOGY-BASED SUBJECTS (e.g. neuroanatomy, neurophysiology, and clinical neurology)?

- It applies more to Neurology-based subjects than it does to learning subjects or disciplines I enjoy least
- It applies to Neurology-based subjects to the same degree as it applies to learning subjects or disciplines I enjoy least
- It applies less to Neurology-based subjects than it does to learning subjects or disciplines I enjoy least
- It does not apply to Neurology-based subjects
- I am not sure

27. What has been your experience of learning NEUROLOGY-BASED SUBJECTS so far?

    Positive   Neutral   Negative   I'm not sure

28. Which of the following **BEST** describes how you approached learning/studying neurology-based subjects? (You may select only one.)

    - Studying to try to better understand the subject
    - Studying only to pass the exam
    - Focusing on memorisation of the subject material
    - I didn't make an effort to learn/study neurology
    - Other (please elaborate)

29. What was the main reason why you approached learning/studying neurology-based subjects by '[chosen reason]'? (You may select only one.)

    - This is how I learn best.
    - This method gets me good grades.
    - This is my usual approach to learning/studying course material.
    - Time was limited.
    - There was a lot to learn.
    - I didn't understand the material.
    - I didn't feel the subject(s) warranted more time or effort.
    - Other (please elaborate)

30. How well do you feel you retain what you learn about neurology-based subjects? [Numbered scale, from 1- I don't retain anything I learn about neurology, to 10 - I remember everything I learn about neurology]

31. What do you feel is the greatest difficulty when learning NEUROLOGY-BASED SUBJECTS? (You may only select one.)

    - I don't find anything difficult about learning neurology-based subjects
    - I don't have a good approach to learning it/I don't know where to start
    - I don't have enough support
    - There isn't enough repeated exposure to the material
    - I don't understand the "basics" of neurology
    - I can't remember what I learn/it doesn't "stick"
    - I worry I will miss something important or make mistakes
    - Neurology-based subjects bring up bad memories - learning them is emotionally difficult
    - There is so much uncertainty in what is known about neurology-based subjects
    - I can't physically see what I'm dealing with
    - I don't have enough time to learn the material
    - There is too much detail and/or volume of material to learn

I have no motivation to learn neurology-based subjects

The teaching is poor

I feel like I am not doing a good job when I try learning neurology

I don't feel like I am making progress to become a vet

Neurology-based subjects make me feel bad about myself and/or my abilities

Other (please elaborate)

32. Do you have difficulty with any of the following when learning neurology-based subjects? (**Please select all that apply.)**

I don't find anything else difficult about learning neurology-based subjects

I don't have a good approach to learning it/I don't know where to start

I don't have enough support

There isn't enough repeated exposure to the material

I don't understand the "basics" of neurology

I can't remember what I learn/it doesn't "stick"

I worry I will miss something important or make mistakes

Neurology-based subjects bring up bad memories - learning them is emotionally difficult

There is so much uncertainty in what is known about neurology-based subjects

I can't physically see what I'm dealing with

I don't have enough time to learn the material

There is too much detail and/or volume of material to learn

I have no motivation to learn neurology-based subjects

The teaching is poor

I feel like I am not doing a good job when I try learning neurology

I don't feel like I am making progress to become a vet

Neurology-based subjects make me feel bad about myself and/or my abilities

Other (please elaborate)

33. If you would like to elaborate on what you find difficult when learning neurology-based subjects, and/or why you have this difficulty(-ies), please do so here.

34. For the following questions, please indicate your agreement with the following statements regarding neurological cases/case studies and learning neurology-based subjects.

If you have not yet learned neurology or cannot recall learning neurology, please answer based on your expectations of the learning process. [5-point Likert scale – Strongly agree to strongly disagree]

As a student learning neurology, when working through case examples, the most important information to learn is the end diagnosis.

When working through neurological cases examples, I value the opportunity to practice the problem-solving process.

If I learn a logical approach to clinical problem-solving I am confident I will be able to reach a diagnosis in my neurological patients.

I find it frustrating to learn a problem-solving approach and prefer to learn the diagnoses.

When working through cases examples, I find it unhelpful to receive feedback on the problem-solving process - what is needed is the diagnosis.

The following questions are intended to gauge views on how easily your knowledge will transfer to a clinical setting.

35. Please drag the marker to indicate your agreement with the following statements on the scales provided: [sliding scale - 1 = strongly disagree to 10 = strongly agree; including a tick box for "I don't know"]

I am confident I could apply the neurology theory I have learned to a clinical situation

I understand what I have learned so far about neurology

What I have learned about neurology is relevant to my future career

I find neurology fascinating

I enjoy learning and/or applying neurology

I find neurology challenging to understand and/or apply

It is easy to see the link between function and clinical signs of neurological disease

If I saw a neurological case in a clinic, I would know 'where to start'

I am worried about my ability to manage neurological patients out in practice

Little can be done for animals with neurological disease

It is difficult to investigate neurological disease in animals

I find neurology scary

Neurological cases are emotionally draining

My experiences of trying to learn neurology make me feel "stupid" or "inadequate"

36. *The following questions were asked as appropriate to the respondents' year of the BVSc degree.*

What was your opinion of neurology and/or neurology-based subjects prior to starting the BVSc course?

Positive | Neutral | Negative

I don't know or I can't remember

What was your opinion of neurology and/or neurology-based subjects when you were in 1st year?

Positive | Neutral | Negative

I don't know or I can't remember

What was your opinion of neurology and/or neurology-based subjects when you were in 2nd year?

Positive | Neutral | Negative

I don't know or I can't remember

What was your opinion of neurology and/or neurology-based subjects when you were in 3rd year?

Positive | Neutral | Negative

I don't know or I can't remember

What was your opinion of neurology and/or neurology-based subjects when you were in 4th year?

Positive | Neutral | Negative

I don't know or I can't remember

What was your opinion of neurology and/or neurology-based subjects when you were in 5th year?

Positive | Neutral | Negative

I don't know or I can't remember

37. If your opinion of neurology and/or neurology-based subjects changed since starting or during the BVSc course, why did it change?

- My opinion has not changed
- I understood it
- I saw how it linked to other subjects
- I realised it's not that hard
- It makes me feel good about myself or proud of my accomplishments
- A teacher changed my opinion
- A case changed my opinion
- I couldn't understand it
- I can't see how it links to other subjects
- It's harder than I thought
- It makes me feel bad about myself and my abilities
- Other (please elaborate)

38. If you would like to provide further information regarding your opinion of neurology-based subjects during your time in the BVSc programme, please do so here.

Section 5: Motivation to learn

We all have different motivations in life; some motivators affect us more than others. The following questions are intended to explore what motivates you and why.

39. How important do you think neurology-based subjects are with regards to your future career plans?

Extremely important	Moderately important	Not at all important
Very important	Slightly important	I don't know

You stated earlier that you plan to pursue [choice from Q4]

40. When did you decide to pursue a career in this professional sector?

Prior to starting the BVSc course	In 3rd year	I can't remember
In 1st year	In 4th year	
In 2nd year	In 5th year	

41. Why have you chosen to pursue a career in this professional sector?

It is just what I have always wanted to do	I find it the most interesting of all my subjects
I have a background in this area	I think it will be challenging
It is what is expected of me	It seems prestigious
I feel I have an affinity with this area	I feel I can make a difference to animals and/or people
Other (please elaborate)	

42. In the veterinary curriculum, students are taught subjects covering a wide range of sectors of the veterinary profession. Some subjects may have little or no perceived relevance to work encountered in another sector.

Has your choice influenced your motivation to study subjects that you consider less relevant to the professional sector you wish to work in?

- Yes – I am less motivated to study subjects I feel are less relevant to my career
- Yes – I am <u>more</u> motivated to study subjects I feel are less relevant to my career
- No – it has had no effect on my motivation to study subjects I feel are less relevant to my career

43. What is your greatest motivator when learning/studying a subject?

Finding the subject interesting

Belief the subject is relevant to my career and/or daily life

Experiences of personal satisfaction relating to the subject

Having a good fundamental understanding on which I can build

Having a good teacher or enthusiastic professional model for the subject

Being surrounded by others who are motivated by the subject

Hands-on or case-based exposure to the subject

Experiences of personal dissatisfaction - desire to learn from mistakes and/or prevent similar feelings

The wish to overcome a mental challenge

The wish to meet others' expectations

The wish to meet my own personal expectations

Being able to pass an examination or gain a credential

Other (please elaborate)]

44. Consider the following. You are about to start a new module in a multi-module course. You have heard that the new module is difficult. Given this information, how would you approach your study of this new module?

Spend the same amount of time studying it as will be spent on each of the modules

Devote extra time to try to understand the difficult module

Leave studying the difficult module until just before the exam

Prioritise studying the difficult module first

Focus on memorisation of the difficult module to ensure the material is covered

Strategically approach study to focus on passing the exam

Not/barely study the difficult module and focus on the other modules to pass the exam

Other (please elaborate)

Section 6: Aspects of veterinary practice that are important to the respondent

The following questions aim to explore what is important to you as a future veterinarian. We all have slightly different views on what the role, function or 'professional identity' of a veterinarian is, and how we see ourselves fitting into that role/function/identity.

The following questions do not relate to any specific discipline.

45. Which of the following do you feel BEST defines the role or requirements of a veterinarian? (You may choose up to THREE statements.)

Providing skilled animal care

Doing everything possible to obtain the optimum patient outcome

Providing a solution for any animal health issue

Communicating knowledge to owners so they can make choices

Guiding owners to make the right choice for their animal

Problem-solving to provide answers to owners

Progression of the veterinary profession through experiential and/or scientific learning

Prioritising client/owner needs, even if life-ending for the animal(s)

Prioritising animal welfare/life, even when at odds with client/owner wishes

Being able to admit our own limitations in knowledge and/or ability

Continuous learning and professional development to improve animal care

Engaging in reflective practice to improve our future performance

Educating clients about ways to improve animal care

Providing emotional support and/or empathy for clients

Providing support for colleagues (emotional, practical, or intellectual)

Other (please elaborate)

46. Drag and drop the following statements to rank their relative importance when you are managing a clinical case of any type or discipline, from most important (rank 1) to least important (rank 10).

(If you have not yet begun clinical rotations, please order them as you believe they are important to a vet in practice.)

Getting a definitive diagnosis

Being able to cure the condition

Achieving results quickly (e.g. examination findings, getting answers, treatment response)

Keeping costs low

Being able to explain the problem to the owner

Appearing to know what I am talking about

Not needing to spend time researching the problem later in the day

Meeting the needs of the owner

Meeting the needs of the patient

Feeling in control/having a plan

We are all subject to expectations - personal, professional, or academic - and may find ourselves under pressure to meet them. The following questions are intended to understand how expectations – your expectations of yourself and others' expectations of you – might influence your approach to a task.

47. Which, if any, of the following cause you the greatest **emotional** difficulty? (Please select 1-3 options that cause you the **most** emotional difficulty.)

Preparing for a test/exam.

Failing a test/exam.

Not meeting others' expectations of me.

Not meeting my own expectations of me.

Feeling like I am not in control.

Not understanding.

Not getting the "right" answer.

Feeling uncertain.

Being hampered by external factors (e.g. teaching, resources, time).

None of the above options cause emotional difficulty for me.

Sections 7 and 8: Measures of perfectionism and tolerance of uncertainty

48. **Perfectionism scale - see Appendix B for the scale.** Below are a series of statements which describe how people may approach a task or personally view their work ethic. Please use the scale below to describe to what extent you agree with each statement (for each item please tick one of the five boxes).

49. **Intolerance of Uncertainty scale - see Appendix B for the scale.** Below are a series of statements which describe how people may react when faced with the need to learn a neurology-based subject or manage a neurological case. Please use the scale below to describe to what extent each item is characteristic of you.

If you would like to make any further comments regarding your opinions or views on neurology-based subjects, or your experiences of learning these subjects, please do so here.

This is the end of the survey. Thank you for your contribution to this research.

Appendix B: Additional Results Tables

Additional table from Chapter 4.

Table B.1 Interviewed participants' pseudonyms and their attitude towards neurology

Self-identified attitude category	Participants
Overall, a negative opinion of neurology and would choose to avoid dealing with neurological cases if possible/if an alternative option is available	Sara Zoe Grace
Some negative perceptions of neurology, but don't allow this to completely put me off neurological cases	Mel Lisa Sienna Jack Emilia
An overall neutral/indifferent attitude towards neurology	James Tessa Heidi Wes Holly
Enthusiastic about neurological cases and enjoy neurology	Max Jenson Charlie Calia Michael

Additional tables and figures from Chapter 5.

Table B.2 Examples of respondents' comments regarding enjoyed or easy aspects of neurology.

Respondents' comments
Respondents who disliked/avoided neurology
"I enjoy a neurology case that I feel I have a handle on, but my expertise are [sic] limited to the basics."
"My interactions with the one neurologist I know … have always been pleasant and enlightening and she has never made me feel stupid or useless, even when my case management is faulty."
"It depends on the diagnosis or clinical signs whether I feel confident about managing any given neurological case."
Respondents who enjoyed neurology
"I find it immensely satisfying to piece the puzzle together from history, exam and diagnostics, to neurolocalise and ddx, to come up with a definitive diagnosis"
"I think the only reason I enjoy neurology is because over the years I have learnt more about it and how to carry out a good neurological exam. And a lot of it was trying to learn myself from scratch. Now, even if I do not get the correct diagnosis, I still feel good that I have done the best to my ability and it doesn't keep me up at night…"
"There is not always a definitive answer from the testing and the confidence to manage the cases is learnt from experience with previous neurology cases."

Table B.3 Examples of respondents' comments regarding difficulties with neurology.

Respondents' comments
Respondents who disliked/avoided neurology
"As students, we don't get enough exposure to these cases and in general, I think GP vets are not very experienced or confident with these cases so it's difficult for them to help/teach younger vets. So it always remains a gap in knowledge."
"As a GP vet with fairly limited neuro experience there seem to be very limited opportunities to learn and improve my ability to manage these cases. Owners are often decline referral and the outcome of these cases is often disappointing."
"It's so emotionally draining as I feel I don't have the answers and can't offer any solutions without a [sic] MRI/CT scan which I don't have access to without referral and frequently the owner can't afford even with insurance."
"As a collective, vets are not people who deal well with not being able to fully understand a problem. I think many vets (in my discussions with them) express that they are not comfortable with anything beyond basic neuro issues (e.g. IVDD). If we can't fully understand, we get frustrated and angry with ourselves and internalise this into statements like "I am not a good enough vet" and so we begin to resent neurology. For myself, I do not like scenarios where I must immediately refer to a specialist because I am not confident with management, because I feel I am not good enough, the client will be unhappy and I am being a burden on the specialists."
"If I try and fail then I am frightened of colleagues/owner/vet board retribution."
"I find it difficult to trust my examination findings, e.g. assessing direct and indirect PLRs correctly."
Respondents who enjoyed neurology
"Sometimes I feel the pressure of the client is on the vet a lot especially for neuro cases. Generally because you can't necessarily see the issue, so the client comes in thinking it will be an easy fix. Or trying to convince the owner that the animal may have a brain tumor even though you may not have access to advanced imaging."
"I find a true and complete neurological exam challenging, and often time prohibitive in a GP environment."
"The thing I find difficult about Neuro is putting together all the clinical exam findings. In a referral setting this is a bit easier as you generally have more time, you can take the animal out the back and perform a whole bunch of tests. In GP we had 15 minutes, sometimes only 10 and that put a lot of strain on coming up with a diagnosis in that time."
"Performing diagnostic investigations on neurological cases is difficult because most of my clients are not interested in tests like CSF taps and advanced imaging for financial reasons."
"Lack of access to advanced imaging - can neurolocalise and come up with ddx, but often cannot get owners a definitive answer. Granted a lot of the time for the patients that require advanced imaging, this may not necessarily change the outcome anyway due to financial limitations"
"A lot of times [you] devise a treatment plan based on assumption like walking blindfolded [and] hoping for the best - scary at first but it gets better with experience [and] learning from mistakes :) (as with everything else right?)"

Table B.4 Examples of respondents' comments regarding experiences of neurology relating to lack of diagnostic investigation and its influence on their perspectives.

Respondents' comments
Negative effects associated with ease of referral
"When I was in a supported practice we did workup inhouse and it was very satisfying. Since being in a practice without supportive colleagues (all other vets are recent graduates who just say "refer" all the time) it has made us not work up cases anymore - we just refer and [it] is very unsatisfying." *(Respondent who disliked/avoided neurology)*
"It is hard to get younger vets to try to work up cases in house. It is frustrating when they refer everything that could be worked up in house. … They graduate being told they should refer everything. I have to remould them to feel confident that they can work cases up and make a diagnosis in house." *(Respondent who disliked/avoided neurology)*
"Neurology and neurological diagnostic techniques such as CSF tap were not taught well at uni and not enough practice on live animals at uni, so graduated feeling that this area was difficult and scary and that feeling has never been dispelled by colleagues who never [sic] say "you can do it/lets [sic] try/that is OK for a GP to do" but rather say "you should refer"......" *(Respondent who disliked/avoided neurology)*
Difficulty accessing diagnostic investigations
"I think neurology in 1st opinion practice is generally very frustrating. Even knowing how to do a proper neuro examination with good lesion localisation does not usually help as the animal will need referral for advanced imaging. There are often cost constraints associated with this leaving us frequently in a situation where we cannot refer the animal but also cannot really treat the animal as we have no diagnosis. The animal often can [sic] have quite severe signs and the owners can get frustrated at how little we can do in-house. Some neuro cases I do enjoy managing such as idiopathic epilepsy where the work-up and treatment can generally be done in-house but this is one of the only situations where I think we can manage cases effectively in 1st opinion practice." *(Respondent who disliked/avoided neurology)*
"As a GP vet with fairly limited neuro experience there seem to be very limited opportunities to learn and improve my ability to manage these cases. Owners are [sic] often decline referral and the outcome of these cases is often disappointing." *(Respondent who disliked/avoided neurology)*
"My struggle is that in neurology you do [a] neurological exam and [the] next step is usually CT scan, like there is no [sic] much I can offer in between. And if pet is not insured then scan barely [sic] ever is an option. Also most of [the] neurological conditions aren't curable." *(Respondent who disliked/avoided neurology)*
"Diagnosis is usually very expensive and requires referral, which means most clients don't do it, which means we are just guessing with treatments and that is really unfulfilling." *(Respondent indifferent to neurology)*
"The main frustration I gave is the lack of affordable imaging. I can, for example, isolate the lesson to a spinal cord segment or via cranial neurological exam... But then what? I've had so few clients accept referral for advanced imaging to narrow down diagnoses. Sometimes I feel like - what's the point of a neuro exam (esp. with suspected intracranial disease) if CSF tap shouldn't be done before CT due to rush of increased generation from high ICP? I often feel trapped." *(Respondent enjoyed neurology)*

Table B.5 The clinical priorities veterinarians considered amongst their three most and three least important priorities and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
Amongst the respondents' 3 most important clinical priorities (*n* = 72)				
Meeting the needs of the owner	10 (22%)	16 (59%)	**<0.01**	0.51 [0.30, 0.84]
Achieving results quickly (e.g. answers, treatment response)	12 (27%)	2 (7%)	0.09	1.51 [1.11, 2.05]
Meeting the needs of the patient	37 (82%)	26 (96%)	0.14	0.66 [0.48, 0.90]
Getting a definitive diagnosis	20 (44%)	7 (26%)	0.19	1.33 [0.95, 1.88]
Being able to cure the condition	13 (29%)	4 (15%)	0.28	1.31 [0.93, 1.86]
Being able to explain the problem to the owner	20 (44%)	15 (56%)	0.5	0.85 [0.59, 1.22]
Feeling in control/having a plan	19 (42%)	10 (37%)	0.85	1.08 [0.76, 1.55]
Amongst the respondents' 3 least important clinical priorities (*n* = 72)				
No need to research the problem later in the day	37 (82%)	25 (93%)	0.3	0.75 [0.51, 1.08]
Achieving results quickly (e.g. answers, treatment response)	10 (22%)	9 (33%)	0.45	0.80 [0.50, 1.27]
Meeting the needs of the owner	8 (18%)	3 (11%)	0.52	1.20 [0.79, 1.81]
Getting a definitive diagnosis	6 (13%)	2 (7%)	0.7	1.23 [0.79, 1.92]
Keeping costs low	28 (62%)	18 (67%)	0.9	0.93 [0.65, 1.34]
Appearing to know what I am talking about	23 (51%)	13 (48%)	1	1.05 [0.73, 1.50]
Being able to cure the condition	10 (22%)	6 (22%)	1	1.00 [0.65, 1.54]
Feeling in control/having a plan	8 (18%)	5 (19%)	1	0.98 [0.61, 1.57]

[a]Data were missing for 4 respondents who disliked/avoided neurology and 6 respondents who enjoyed neurology.

[b]Percentages reflect the proportion of respondents in each attitude category.

Statements selected by fewer than 10 respondents were excluded from the table due to low numbers.

Table B.6 The most common factors that made veterinarians feel "successful" or caused the greatest difficulty relating to veterinary cases and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
Most likely to make feel "successful" with a veterinary case of any discipline (*n* = 77)			0.99	
Helping the patient – even if that is life-ending	22 (49%)	18 (64%)		REF
Finding an answer for the problem	7 (16%)	3 (11%)		0.79 [0.48, 1.29]
Feeling I had personally made a difference	4 (9%)	3 (11%)		0.96 [0.48, 1.94]
'Fixing' the problem	4 (9%)	3 (11%)		0.96 [0.48, 1.94]
Having the owner feel satisfied with my performance	4 (9%)	2 (7%)		0.83 [0.44, 1.55]
The patient being able to go home	3 (7%)	2 (7%)		0.92 [0.43, 1.98]
The greatest difficulty when dealing with a veterinary case of any discipline (*n* = 71)			0.42	
Balancing external limitations and optimum patient care	24 (53%)	17 (65%)		REF
Time pressures preventing completion of tasks to a standard with which I am happy	9 (20%)	2 (8%)		0.72 [0.49, 1.05]
Feeling that I am not good/knowledgeable enough	5 (11%)	1 (4%)		0.70 [0.45, 1.09]
Meeting my expectations of myself	4 (9%)	1 (4%)		0.73 [0.44, 1.22]

[a]Data were missing for 4 respondents who disliked/avoided neurology. Of those that enjoyed neurology, data were missing for most likely to make the respondent feel "successful" (*n* = 1) and greatest difficulty when dealing with a veterinary case (*n* = 7).

[b]Percentages reflect the proportion of respondents in each attitude category.

Statements selected by fewer than 5 respondents were excluded from the table due to low numbers.

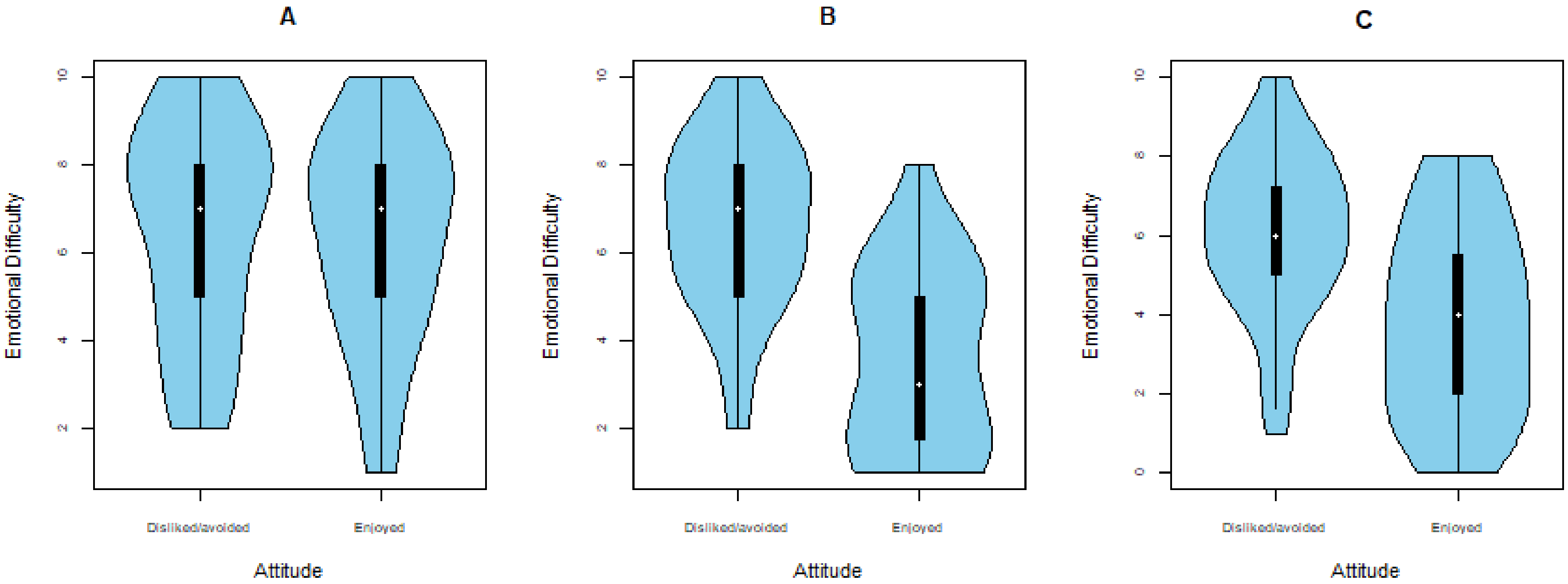
REF = reference statement for prevalence ratio calculation.

Table B.7 Veterinarians' positivity towards, and expectations of, neurological cases and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 82 respondents; 49 who disliked/avoided neurology and 33 who enjoyed neurology[a].

	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Disliked/avoided	Enjoyed		
How often you feel positive (in general) about a neurological case (*n* = 73)			**<0.0001**	
Always or almost always	0 (0%)	2 (7%)		NC
Most of the time	1 (2%)	18 (64%)		14.53 [2.14, 98.79]
Sometimes	26 (58%)	8 (29%)		REF
Not very often	15 (33%)	0 (0%)		0.76 [0.63, 0.92]
Never or hardly ever	3 (7%)	0 (0%)		0.76 [0.63, 0.92]
How often you are happy with your evaluation and understanding of a neurological case (*n* = 73)			**<0.0001**	
Always or almost always	0 (0%)	0 (0%)		NC
Most of the time	5 (11%)	20 (71%)		4.14 [1.86, 9.20]
Sometimes	29 (64%)	6 (21%)		REF
Not very often	9 (20%)	2 (7%)		1.01 [0.74, 1.39]
Never or hardly ever	2 (4%)	0 (0%)		0.83 [0.71, 0.96]
How often you feel positively about the outcome of a neurological case (*n* = 73)			**<0.001**	
Always or almost always	0 (0%)	0 (0%)		NC
Most of the time	4 (9%)	12 (43%)		2.54 [1.05, 6.12]
Sometimes	26 (58%)	15 (54%)		REF
Not very often	14 (31%)	1 (4%)		0.68 [0.52, 0.89]
Never or hardly ever	1 (2%)	0 (0%)		0.63 [0.50, 0.80]
Before a neurological case, I expect difficulty (intellectual or emotional) (*n* = 73)			**<0.001**	
Agree	34 (76%)	9 (32%)		REF
Neither agree nor disagree	11 (24%)	14 (50%)		1.80 [1.13, 2.87]
Disagree	0 (0%)	5 (18%)		Invalid
After seeing the case, it often doesn't seem as bad as I expected (*n* = 73)			**0.13**	
Agree	7 (16%)	10 (36%)		1.60 [0.88, 2.93]
Neither agree nor disagree	31 (69%)	16 (57%)		REF
Disagree	7 (16%)	2 (7%)		0.85 [0.57, 1.27]

[a]Data were missing for 4 respondents who disliked/avoided neurology and 5 respondents who enjoyed neurology.
[b]Percentages reflect the proportion of respondents in each attitude category.
NC = Not able to calculate because of zero values.
REF = reference statement for prevalence ratio calculation.
Due to rounding percentages may not equal 100.

Appendix B: Additional Results Tables



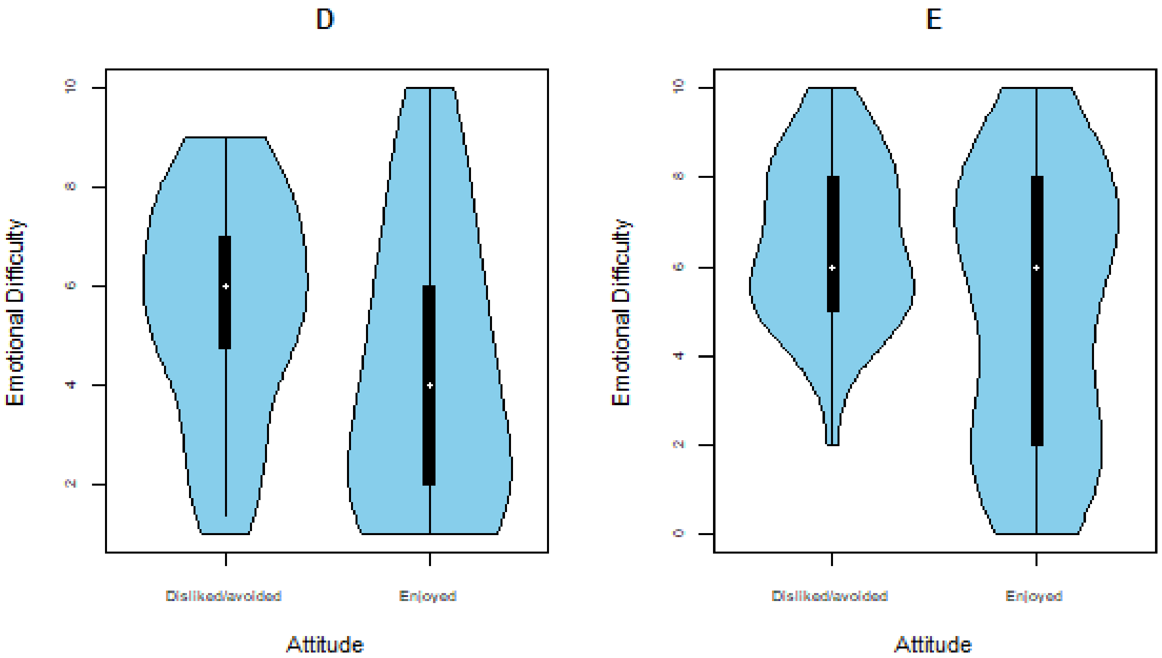
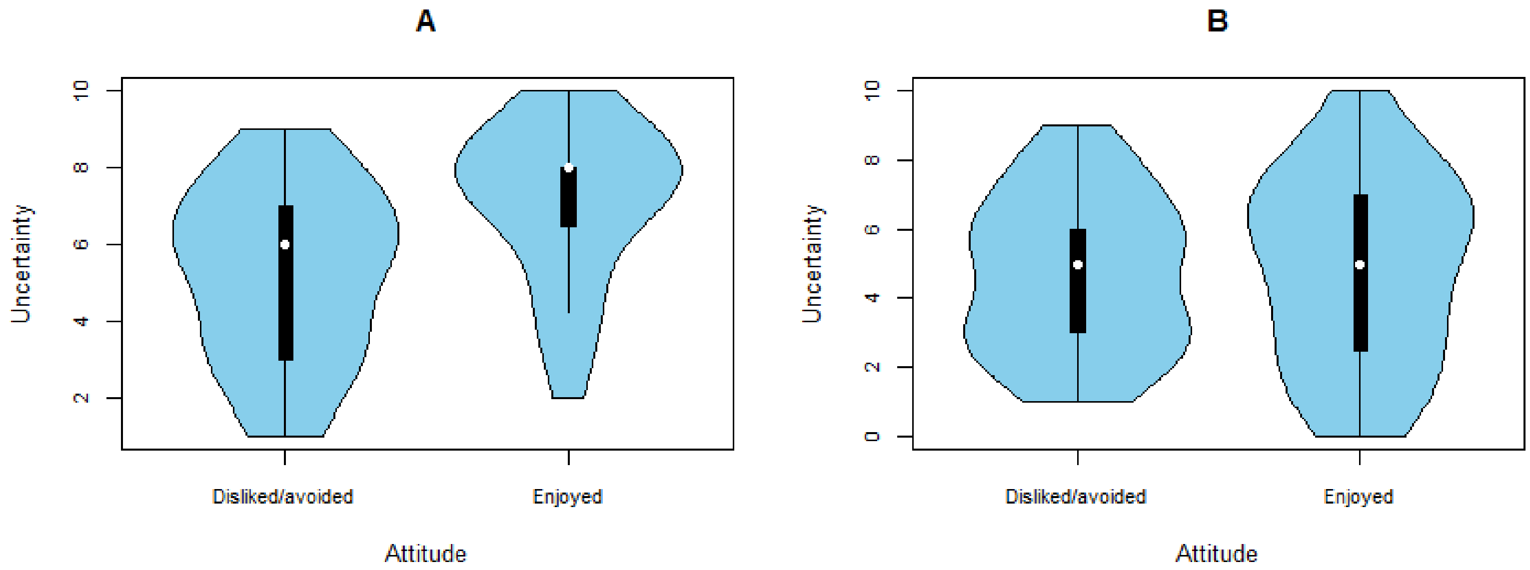


Figure B.1 Distribution of emotional difficulty scores for aspects of neurological cases amongst respondents who disliked/avoided and enjoyed neurology. The violin plots depict respondents' scores of emotional difficulty when dealing with neurological cases, relating to A) limitations from external factors (e.g. financial, access to diagnostic investigations, owner unwillingness) (p = 0.79), and limitations in respondents' B) understanding (***p*<0.001**), and ability to C) make a plan (***p*<0.001**), D) make a positive difference (***p* = 0.04**), and E) get a definitive diagnosis (p = 0.05). The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values. Possible scores range from 0-10. Higher scores indicate greater emotional difficulty.



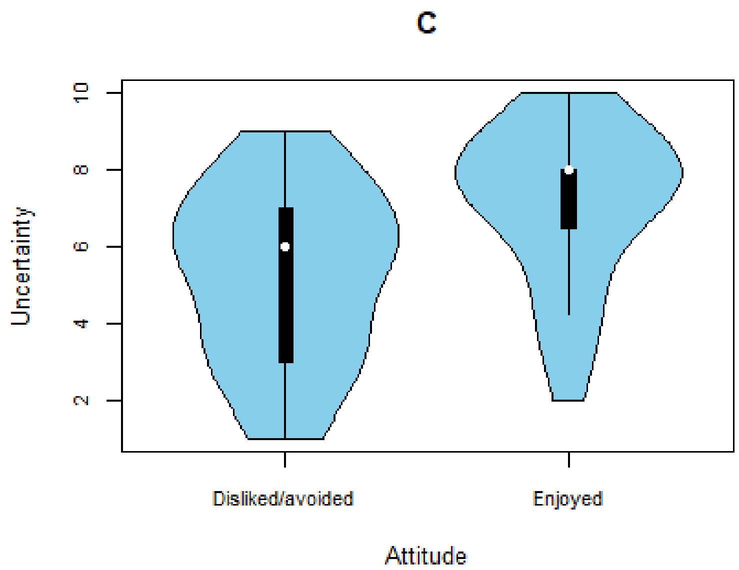


Figure B.2 Distribution of level of agreement scores for statements relating to uncertainty amongst respondents who disliked/avoided and enjoyed neurology. **The violin plots** depict respondents' level of agreement with the statements A) I am comfortable dealing with uncertainty when working (***p* <0.001**), B) I am comfortable dealing with uncertainty in my personal life (*p* = 0.69), and C) I struggle with uncertainty more when the stakes are higher (*p* = 0.71)**. The width of the violin at any point indicates the frequency or density of data points at that level. The box represents the limits of the upper and lower quartile, and the white dot is the median. The whiskers are the upper and lower adjacent values and values beyond the range indicate unusual values.** Possible scores range from 0-10. Higher scores indicate greater agreement with the statement.

Additional tables from Chapter 6.

Table B.8 Respondents' perceptions of their experience of neurological disease in humans or animals and the prevalence ratio of disliking/avoiding neurology. Data from 39 survey respondents; 14 who had experience of neurological disease only in humans and 25 who had experience of neurological disease only in animals.

Variable	Number (%)[b]		*P*	Prevalence ratio [95% CI]
	Only humans	Only animals		
Experience helped understanding of neurology (*n* = 34)			0.09	
Yes	4 (31%)	13 (54%)		REF
Maybe	3 (23%)	8 (33%)		0.86 [0.24, 3.14]
No	6 (46%)	3 (13%)		0.35 [0.13, 0.93]
How experience influenced view of neurology (*n* = 34)				
Showed neurological diseases are unfair[d]	5 (42%)	0 (0%)	**<0.01**	4.14 [2.17, 7.90]
Can make positive differences to patient lives[c]	6 (50%)	6 (27%)	0.27	1.83 [0.76, 4.45]
Showed neurological diseases are life-altering[e]	8 (67%)	9 (41%)	0.28	2.00 [0.74, 5.41]
Put off learning more about neurology[d]	2 (17%)	1 (5%)	0.28	2.07 [0.80, 5.34]
Showed we can improve or cure neurological disease[c]	2 (17%)	7 (32%)	0.44	0.56 [0.15, 2.07]
Increased interest[c]	6 (50%)	7 (32%)	0.46	1.62 [0.66, 3.96]
Wish to better understand[e]	7 (58%)	15 (68%)	0.71	0.76 [0.31, 1.89]
Showed little can be done[d]	2 (17%)	5 (23%)	1	0.77 [0.22, 2.75]
How experience influenced view of neurology (*n* = 34)				
Both positive and negative influences selected	6 (50%)	2 (9%)	**0.01**	3.25 [1.45, 7.29]
Negative influences selected	7 (58%)	6 (27%)	0.14	2.26 [0.91, 5.65]
Positive influences selected	9 (75%)	13 (59%)	0.47	1.64 [0.54, 4.92]
Influences may be a neutral statement	9 (75%)	17 (77%)	1	0.92 [0.33, 2.61]

[a]Data were missing from 2 respondents whose experience of neurological disease was only in humans and 3 respondents whose experience of neurological disease was only in animals.

[b]Percentages reflect the proportion of respondents in each species category.

Influence on neurology: [c] positive, [d] negative, [e] may be a neutral statement

REF = reference statement for prevalence ratio calculation.

When multiple variables could be selected for the question, *P*-values were calculated comparing the number of respondents that selected each variable to the number that did not.

Due to rounding percentages may not equal 100.

Table B. 9 How much of what they had learnt respondents believed they had retained for different methods of studying/learning neurology and the prevalence ratio of disliking/avoiding neurology. Data from 58 surveyed respondents; 37 who studied to understand, 12 who studied by memorisation, and 9 who studied strategically to pass the examination

Variable	Retained little or nothing *n* (% of 18)	Retained some or most *n* (% of 35)	*P*	Prevalence ratio [95% CI]
Studied to understand neurology (*n* = 34)			**0.01**	0.36 [0.17, 0.76]
Yes	7 (39%)	27 (77%)		
No	11 (61%)	8 (23%)		
Studied neurology by memorising details (*n* = 10)			**0.02**	1.82 [0.97, 3.44]
Yes	7 (39%)	3 (9%)		
No	11 (61%)	32 (91%)		
Studied neurology to pass the examination (*n* = 9)			0.715	2.74 [1.43, 5.25]
Yes	4 (22%)	5 (14%)		
No	17 (78%)	30 (86%)		

[a]Data were missing from 3 respondents who studied to understand, and 2 respondents who studied by memorising details.

Table B.10 Respondents' reasons for choosing their method of studying/learning neurology and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable and Reason Selected	Disliked/avoided *n* (%)	Enjoyed *n* (%)	*P*	Prevalence ratio [95% CI]
Studied to try to better understand (*n* = 37)			**0.03**	
Usual method	5 (45%)	12 (46%)		REF
Didn't understand	2 (18%)	0 (0%)		0.29 [0.14, 0.61]
Gets good grades	2 (18%)	0 (0%)		0.29 [0.14, 0.61]
How I learn best	1 (9%)	10 (38%)		3.24 [0.43, 24.11]
A lot to learn	1 (9%)	3 (12%)		1.18 [0.18, 7.48]
Limited time	0 (0%)	0 (0%)		—
Other	0 (0%)	1 (4%)		NC
Focused on memorisation (*n* = 12)			0.3	
A lot to learn	5 (50%)	0 (0%)		REF
Limited time	2 (20%)	1 (50%)		1.50 [0.67, 3.34]
Didn't understand	1 (10%)	0 (0%)		1.00 [1.00, 1.00]
Gets good grades	1 (10%)	0 (0%)		1.00 [1.00, 1.00]
How I learn best	0 (0%)	1 (50%)		NC
Usual method	0 (0%)	0 (0%)		—
Other	1 (10%)	0 (0%)		1.00 [1.00, 1.00]
Studied only to pass the exam (*n* = 9)			1	
A lot to learn	4 (67%)	2 (67%)		REF
Limited time	1 (17%)	1 (33%)		1.33 [0.30, 5.96]
Didn't understand	1 (17%)	0 (0%)		0.67 [0.38, 1.17]
Usual method	0 (0%)	0 (0%)		—
Gets good grades	0 (0%)	0 (0%)		—
How I learn best	0 (0%)	0 (0%)		—
Other	0 (0%)	0 (0%)		—

[a]Data were missing for 24 respondents who disliked/avoided neurology and 18 respondents who enjoyed neurology.

Percentages reflect the proportion of respondents in each attitude category who selected the reason to explain why they studied neurology the way they did.

NC = Not able to calculate because of zero values.

REF = reference statement for prevalence ratio calculation.

Due to rounding percentages may not equal 100.

Table B.11 Examples of respondents' comments regarding workload when stating difficulties encountered learning neurology

Respondents' comments
"The stuff I had time to learn well I enjoy but the majority of CNS diseases, especially in small and equine patients we had far too much jammed into small time slots and I never had time to learn it."
"I feel like it is such a big subject and we don't get enough time."
"The volume needed to learn as well as all our other courses means that we have to pick and choose what we learn."
"Unfortunately like with most vet subjects I feel the subjects are too rushed."
"Trying to learn it all at once for the first time while being time pressured for test preparation and other topics I need to study meant Neurology had to become a memorise it subject, not an understand it subject (which takes me longer than simply memorising potential answers)."
"Neurology has made up a small percentage of our learning to date and a tiny percent of the enormous volume of information we learn/get tested on therefore I put the least effort into it. When it comes to studying, I focus more on % makeup of the exam so I can ensure that I pass."

Table B.12 Respondents' motivation when studying/learning a subject and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 41)	Enjoyed *n* (% of 35)	*P*	Prevalence ratio [95% CI]
Greatest motivator when learning/studying a subject (*n* = 76)			0.40	
Finding the subject interesting[b]	10 (24%)	8 (23%)		REF
Belief the subject is relevant to me[c]	6 (15%)	8 (23%)		1.30 [0.62, 2.70]
A good teacher or enthusiastic professional model[c]	10 (24%)	6 (17%)		0.89 [0.51, 1.56]
Having a good fundamental understanding	5 (12%)	4 (11%)		1.00 [0.49, 2.05]
Experiences of personal satisfaction for the subject[b]	2 (5%)	5 (14%)		1.94 [0.56, 6.73]
Being able to pass an examination/gain a credential[c]	4 (10%)	0 (0%)		0.56 [0.37, 0.84]
Hands-on or case-based exposure to the subject[c]	3 (7%)	1 (3%)		0.74 [0.37, 1.49]
The wish to meet my own personal expectations[b]	1 (2%)	2 (6%)		1.67 [0.32, 8.70]
Being around others who are motivated[c]	0 (0%)	0 (0%)		Not tested
Approach to study of difficult modules (*n* = 76)			0.31	
Devote extra time to try to understand it	17 (41%)	16 (46%)		REF
Study the difficult module first	7 (17%)	7 (20%)		1.03 [0.55, 1.91]
Strategically study to focus on passing the exam	5 (12%)	6 (17%)		1.13 [0.55, 2.34]
Spend the same time studying it as other modules	5 (12%)	6 (17%)		1.13 [0.55, 2.34]
Memorise the difficult module to cover the material	5 (12%)	0 (0%)		0.52 [0.37, 0.72]
Not/barely study it – pass the exam with other modules	1 (2%)	0 (0%)		0.52 [0.37, 0.72]
Leave studying it until just before the exam	1 (2%)	0 (0%)		0.52 [0.37, 0.72]
Effect on motivation if subjects deemed less relevant (*n* = 76)			0.77	
Less motivation	20 (49%)	18 (51%)		REF
No effect on motivation	15 (37%)	14 (40%)		1.02 [0.64, 1.62]
Increased motivation	6 (15%)	3 (9%)		0.79 [0.45, 1.37]

[a]Data were missing for 10 respondents who disliked/avoided neurology and 14 respondents who enjoyed neurology.

[b]Statements suggested internal motivation.

[c]Statements suggested external motivation.

REF = reference statement for prevalence ratio calculation.

Due to rounding percentages may not equal 100.

When respondents could choose only one motivator, neither statements that suggested internal motivation or external motivation were significantly more or less likely amongst respondents who disliked/avoided neurology.

Table B.13 Factors respondents believed defined the roles or requirements of veterinarians and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 41)	Enjoyed *n* (% of 34)	*P*	Prevalence ratio [95% CI]
Providing a solution for any animal health issue[c]	6 (15%)	0 (0%)	**0.03**	1.97 [1.56, 2.49]
Guiding owners to make the right choice for their animal	9 (22%)	12 (35%)	0.31	0.72 [0.42, 1.24]
Continuous learning and professional development[b]	12 (29%)	14 (41%)	0.40	0.78 [0.48, 1.26]
Admitting our own limitations in knowledge and/or ability	5 (12%)	2 (6%)	0.45	1.35 [0.80, 2.27]
Engaging in reflection to improve future performance[b]	1 (2%)	2 (6%)	0.59	0.60 [0.12, 3.01]
Progression of the profession through learning[b]	1 (2%)	2 (6%)	0.59	0.60 [0.12, 3.01]
Communicating knowledge for owners to make choices	22 (54%)	16 (47%)	0.74	1.13 [0.74, 1.71]
Problem-solving to provide answers to owners[c]	9 (22%)	6 (18%)	0.86	1.12 [0.70, 1.81]
Doing everything possible to get optimum patient outcome	11 (27%)	8 (24%)	0.95	1.08 [0.69, 1.70]
Providing skilled animal care	25 (61%)	21 (62%)	1	0.99 [0.65, 1.50]
Educating clients about ways to improve animal care	9 (22%)	7 (21%)	1	1.04 [0.63, 1.70]
Prioritising animal welfare/life, no matter client wishes	7 (17%)	5 (15%)	1	1.08 [0.64, 1.84]
Providing emotional support and/or empathy for clients	2 (5%)	1 (3%)	1	1.23 [0.54, 2.82]
Providing support for colleagues	1 (2%)	1 (3%)	1	0.91 [0.22, 3.71]
Prioritising client needs, even if life-ending	1 (2%)	0 (0%)	1	1.85 [1.50, 2.28]

[a]Data were missing for 10 respondents who disliked/avoided neurology and 15 respondents who enjoyed neurology.

[b]Factors associated with gaining clinical answers.

[c]Factors associated with gaining personal knowledge.

Statements associated with gaining clinical answers were ‘Problem-solving to provide answers to owners’ and ‘Providing a solution for any animal health issue’.

Statements associated with gaining personal knowledge were ‘Continuous learning and professional development’, ‘Engaging in reflection to improve future performance’, and ‘Progression of the profession through learning’.

Table B.14 Clinical priorities respondents rated most and least important and the prevalence ratio of disliking/avoiding neurology. Data from a survey of 100 respondents; 51 who disliked/avoided neurology and 49 who enjoyed neurology[a].

Variable	Disliked/avoided *n* (% of 41)	Enjoyed *n* (% of 32)	*P*	Prevalence ratio [95% CI]
Amongst 3 most important priorities				
Meeting the needs of the patient	35 (85%)	31 (97%)	0.13	0.62 [0.42, 0.90]
Meeting the needs of the owner	19 (46%)	20 (63%)	0.26	0.75 [0.50, 1.13]
Achieving results quickly	9 (22%)	4 (13%)	0.46	1.30 [0.84, 2.00]
Getting a definitive diagnosis	13 (32%)	7 (22%)	0.50	1.23 [0.82, 1.85]
Being able to cure the condition	8 (20%)	9 (28%)	0.56	0.80 [0.46, 1.38]
Feeling in control/having a plan	12 (29%)	7 (22%)	0.66	1.18 [0.77, 1.80]
Being able to explain the problem to the owner	20 (49%)	16 (50%)	1	0.98 [0.65, 1.47]
Amongst 3 least important priorities				
Appearing to know what I am talking about	24 (59%)	29 (91%)	**<0.01**	0.53 [0.38, 0.75]
Not needing to spend time researching later in the day	31 (76%)	28 (88%)	0.33	0.74 [0.49, 1.11]
Getting a definitive diagnosis	10 (24%)	5 (16%)	0.53	1.25 [0.81, 1.92]
Keeping costs low	14 (34%)	9 (28%)	0.77	1.13 [0.74, 1.71]
Achieving results quickly	11 (27%)	7 (22%)	0.83	1.12 [0.72, 1.74]
Feeling in control/having a plan	15 (37%)	12 (38%)	1	0.98 [0.64, 1.50]
Being able to cure the condition	6 (15%)	4 (13%)	1	1.08 [0.62, 1.88]

[a]Data were missing for 10 respondents who disliked/avoided neurology and 17 respondents who enjoyed neurology.