VET nuus•news

Julie / July 2026

The Monthly Magazine of the SOUTH AFRICAN VETERINARY ASSOCIATION
Die Maandblad van die SUID-AFRIKAANSE VETERINÊRE VERENIGING



THEME

The Oodles

CPD

Ophthalmological disorders of backyard poultry

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Dagboek • Diary



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July 2026

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10-11 July
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Info: conference@savetcon.co.za

Integrative Veterinary Medicine Conference
31 July - 02 August
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Info: conference@savetcon.co.za

Western Cape Branch of the SAVA Congress
31 July – 01 August
Venue: Devonvale Golf & Wine Estate, Stellenbosch
Info: Vetlink on conferences@vetlink.co.za

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13 - 15 April 2027

Venue: To be confirmed (Gauteng)

Info: corne@savetcon.co.za



August 2026

Hill's Nurses Hybrid Weekend
01-02 August
Venue: Cradle Moon, Muldersdrift
Info: corne@savetcon.co.za

SAVA Free State & Northern Cape Congress
14-15 August
Venue: Protea Hotel, Kimberley
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23rd Annual SASVEPM Congress
19 - 21 August
Venue: Sun City Resort, Rustenburg, North West
Info: https://sasvepm.org/23rd-annual-sasvepm-congress/

54th Annual PARSA Conference
31 August – 02 September
Venue: Klein-Kariba, Bela-Bela
Info: corne@savetcon.co.za

September 2026

SAVA Mpumalanga Branch
04 – 05 September
Venue: TBC
Info: conference@savetcon.co.za

Virology Africa Congress
15 - 18 September
Venue: Skukuza, Kruger National Park
Info: Vetlink: https://virologyafrica2026.co.za/

NVCG: Veterinary Masterclass: Medicine & Dermatology
19 - 20 September
Venue: Johannesburg, Midrand Premier Hotel
21 - 22 September
Venue: Protea Hotel Stellenbosch (Techno Park)
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30 September - 01 October
Venue: Krystal Beach Hotel, Gordon's Bay
Info: conference@savetcon.co.za

October 2026

Northern KZN and Midlands Branch of SAVA Congress
09 – 10 October
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November 2026

Southern Cape Branch of the SAVA Congress
06 – 07 November
Venue: To be confirmed
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Poultry Group of SAVA
11– 13 November
Venue: Misty Hills Country Estate, Muldersdrift, Gauteng
Info: corne@savetcon.co.za



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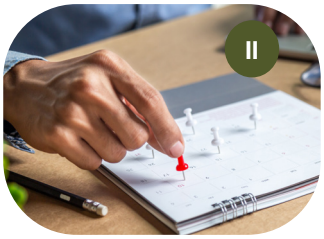
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From Crossbreeds to Council Meetings: Keeping Members Informed



Dear members,

Warm July greetings to all SAVA members.

As we move into the second half of the year, VetNews reflects on the theme of crossbred versus purebred animals — a topic that invites both professional reflection and public education. It also dovetails well with SAVA's recent media engagements, including a radio interview on the cost of ownership of some dog breeds compared with others. These conversations are important, as they help the public make informed decisions while highlighting the value of veterinary guidance in responsible animal ownership.

The SAVA Board met on 19 June 2026, following FINCO and EXCO meetings in May, with several important matters on the agenda. Foremost among these were the broader and persistent concerns relating to veterinary pharmaceuticals. These concerns extend beyond medicine shortages and include issues of availability, regulatory gaps, the judicious use of antimicrobials, oversight, compounding, supply chain vulnerabilities, and the practical impact of the current regulatory environment on veterinary practice.

More specifically, the ongoing concerns around the availability of phenobarbitone preparations were highlighted. Following the Board meeting, SAVA engaged both the manufacturer and the South African Health Products Regulatory Authority (SAHPRA) in an effort to support an expedited and practical solution, while fully respecting SAHPRA's regulatory mandate and the need to maintain appropriate production and quality standards. This engagement is ongoing, and the Board continues to keep a close eye on developments.

The envisaged engagement with SAHPRA on the broader availability of veterinary pharmaceuticals and opportunities for collaboration has also been scheduled for the third week of July. SAVA views this as an important opportunity to raise the challenges experienced by veterinarians and to explore sustainable solutions for the profession and the animal health sector.

We are also pleased to report that, following the emigration of Dr Lomberg, SAVA approached Dr Charlotte Nkuna to head the Vets in Industry Group. Dr Nkuna has graciously agreed to take on this responsibility. We warmly welcome her in this role and have every confidence that she will make a meaningful contribution and successfully guide this important group going forward.

The SAVA Board of Directors is also engaging various stakeholders regarding the formation of a veterinary-led Animal Health Forum. This initiative is aimed at ensuring that veterinarians work collaboratively and remain central to the management of animal health in support of the agricultural sector, food security, public health, and animal welfare.

In July, SAVA also looks forward to engaging with the Health and Welfare Sector Education and Training Authority (HWSETA) on matters related to the mentorship programme and the future of development programmes. This engagement is important as we continue to consider how best to support young veterinarians, strengthen professional development pathways, and contribute to building capacity within the veterinary profession.

The SAVA Board of Directors also recently met with the Executive Committee of the South African Veterinary Council. The engagement was constructive and covered several matters of concern to members and the profession. Among the issues discussed were lay persons providing veterinary services, lay persons administering rabies vaccinations, and veterinarians selling scheduled medicines to lay persons across the various schedules. The recommended outcome was that SAVA would make a written submission to the SAVC on these matters.

Members are therefore requested to continue reporting cases of this nature to SAVA so that these concerns can be properly collated and submitted through the appropriate channels.

SAVA also discussed the shortage of phenobarbitone and the steps being taken to address broader concerns regarding the availability and regulation of veterinary pharmaceuticals.

SAVA further requested that the SAVC provide periodic reports on matters involving lay persons performing veterinary work and related transgressions that are being prosecuted.

Council indicated that this would be possible, which should assist in keeping the profession better informed on how these matters are being addressed.

Concerns raised by members regarding the SAVC investigations and complaints management process were also discussed. These included issues relating to procedure, timelines, and feedback mechanisms. It was agreed that SAVA should make a written submission to the SAVC outlining these concerns. Members are requested to forward any additional issues they would like SAVA to raise in this submission. Members are also encouraged to report transgressions in these areas.

Importantly, SAVA and the SAVC also agreed that support to veterinarians who find themselves at odds with Council should be approached collaboratively. This is an important step towards ensuring that members are supported fairly, constructively, and within the framework of professional accountability.

Further matters discussed included information sharing on the regulation and scope of work of veterinarians and other veterinary professionals. SAVA will, in the next month, use the rules shared by SAVC with all registrees to create posters and other easily accessible materials from these to distribute to practices nationally for ease of reference. Any summaries made by SAVA must be based on their interpretation of the rules, and it is best for members to always enquire with SAVC and/or refer to the rules when in doubt.

Discussions were also held regarding tariff guidelines for the professions. In this regard, it was agreed that SAVA and the SAVC will jointly approach the Competition Commission for guidance to ensure that any work in this area is undertaken appropriately and in compliance with competition law requirements.

We also pause to remember members of the SAVA family who have passed away since March 2026. We extend our sincere condolences to the families, friends and colleagues of Dr Adrian John Frederick Rogers, Dr Jean-Claude Jacobs and Dr Daniel Wynand Verwoerd. Their contribution to the veterinary profession is remembered with gratitude and respect.

We further keep in our thoughts colleagues who are unwell and wish them strength, comfort and a full recovery. I would also like to thank colleagues and the greater sector community for their generous contributions to the BackaBuddy

fundraiser initiated to assist a colleague. The fund currently stands at 79% of the envisaged R225,000, with R178,774 collected to date. Let us continue to support this initiative, which can be found at: https://www.backabuddy.co.za/campaign/lets-rally-behind-tod.

It is also important that we celebrate the achievements of our colleagues. SAVA extends heartfelt congratulations to Prof Johan Schoeman, who has been awarded the MT Steyn Prize for Natural Sciences and Technological Sciences of the South African Academy for Science and Arts for 2026. This is a significant honour and a proud moment for the Faculty of Veterinary Science and the profession at large.

We also congratulate Prof Nenene Qekwana on his appointment as Head of the ARC Onderstepoort Veterinary Research Institute. We wish him every success in this important leadership role and look forward to the contribution he will continue to make to veterinary science, research, and animal health in South Africa.

Congratulations are also extended to Dr Jonathan Wimberley, whose recent graduation was an extra-special double celebration. In addition to receiving his Bachelor of Veterinary Science degree from the University of Pretoria, he was awarded the Vice-Chancellor and Principal's Medal for top performance in his graduating class. This is an outstanding achievement and a wonderful reflection of the future of our profession.

Lastly, I wish to extend my warmest congratulations to Dr Tod Collins on being awarded the prestigious President's Award for 2025.

This award represents one of the highest forms of recognition within the profession and is reserved for colleagues who have demonstrated consistent excellence and service over long and illustrious careers. It is bestowed on a veterinarian registered with the South African Veterinary Council in recognition of outstanding service to, and advancement of, the veterinary profession in South Africa.

The President's Award is not granted lightly. It requires a clear and strong demonstration of the recipient's sustained contribution, leadership, service, and impact. Dr Collins' selection is therefore a fitting acknowledgement of his dedication to the profession and the meaningful role he has played in advancing veterinary services and the profession.

The award was bestowed upon Dr Tod Collins on behalf of SAVA at the RUVASA Congress Gala Dinner held on 9 June 2026. We congratulate Dr Collins on this well-deserved honour and thank him for his commitment, contribution, and service to the veterinary profession.



Congratulations, Dr Collins.

These engagements, moments of remembrance, achievements, and public conversations all reflect the richness of our profession: its challenges, its people, its service, and its excellence. Whether we are speaking about the health implications of breed choices, access to essential medicines, professional regulation, mentorship and development, or the recognition of veterinary excellence, SAVA remains committed to supporting the profession and keeping members informed.

Groetnis,

Dr. Ziyanda Majokweni – Qwalela
President: South African Veterinary Association

CREDO

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We, the members of the Association, resolve at all times:

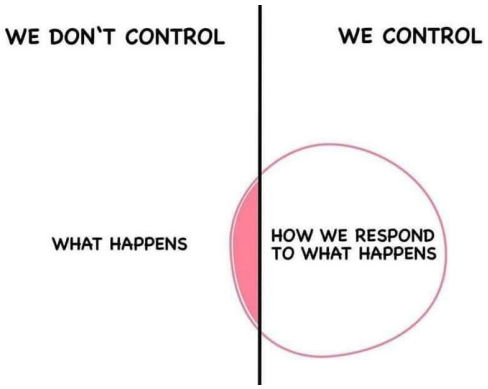
- To honour our profession and the Veterinary Oath
- To maintain and uphold high professional and scientific standards
- To use our professional knowledge, skills and resources to protect and promote the health and welfare of animals and humans
- To further the status and image of the veterinarian and to foster and enrich veterinary science
- To promote the interests of our Association and fellowship amongst its members.

Ons, die lede van die Vereniging, onderneem om te alle tye:

- Ons professie in ere te hou en die Eed na te kom
- 'n Hoë professionele en wetenskaplike peil te handhaaf en te onderhou
- Ons professionele kennis, vaardigheid en hulpbronne aan te wend ter beskerming en bevordering van die gesondheid en welsyn van dier en mens
- Die status en beeld van die veearts te bevorder en die veeartsenykunde te verryk
- Die belange van ons Vereniging en die genootskap tussen sy lede te bevorder.



Editor's notes / Redakteurs notas

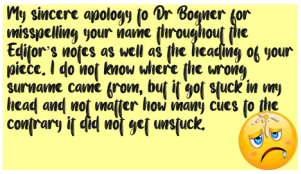


The great Poo debate

Americans have a national day for practically anything under the sun, with no exception, the National Day (in the US) of Mutts is celebrated on the 31st of July. As I know that Poodle cross-breeds are very popular in parts of the world, I delved a little into some more of the scientific write-ups on these dogs. I found two articles that I hope may be interesting to read. You can also find 2 more articles, the one on Cardiomyopathies and Equine spine surgery.

At the end of the year, I draw up a list of topics for the next year. It is only a guideline of what may be included. There are certain months that are dedicated to specific events in the month or the preceding one. To find new and read-worthy contents is not always easy. I was confronted last month by a veterinarian on the content of Vetnews.

One was the very bad mistake of Dr Bogners' name in my Notes and the heading to the piece that he wrote. See the box for my apology. The other was that there should be more member-related content. I wish that I could get more content from members.



It is the VetNews by all means and should reflect news about members. But it is very difficult to do without the input from members.

There are many veterinarians with very interesting hobbies. I would love to hear from you. If you want to do a short interview that I can process into an article, I am sure it can be inspirational to other members. Who ran the Comrades marathon? Who does Hybrid Sport like Hyrox or Cross-Fit? Who does the Iron Man? Who climbed Mount Kilimanjaro? This is all stuff that I would love to post. Is there maybe a partner (wife or husband) who wants to send something about being the partner of a Vet? I will soon be in touch with groups and branches regarding their congresses and other activities. I would like to get reports and photos back to post. It is always great to see colleagues being involved and ageing with all of the others. I know many members have children who have qualified as Veterinarians. Please get in touch with me if a son or daughter of yours is also a veterinarian or studying to become one. There is a short piece on Dr Johnathan Wimberley, whose graduation was recent, who is the son of Dr Steve Wimberley. Congratulations also to Dr Wimberley.

Pay very close attention to the Life coaching contribution by Dr Mats Abatzidis. The topic can not be more applicable, especially this time of year, when nerves may be wearing thin. This is the time to draw together and pull the wagon through the ditch (freely translated from Afrikaans). I want to frame the last part of it and put it on a fridge in every practice in the country.

I hope everybody has a warm July and that life and colleagues treat you well.

Andriette





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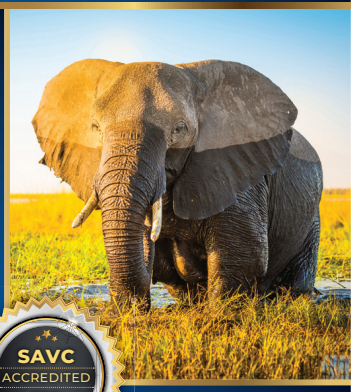
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Helicopter/Feline Stress/VNews

Comparing undesirable behaviours between 'designer' Poodle-cross dogs and their purebred progenitor breeds

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Abstract

Designer-crossbreed dogs (deliberate cross-breeding between two or more pure breeds) are exploding in popularity, often driven by beliefs that they commonly exhibit desirable behaviours such as being easy to train or being good with children, despite minimal supporting evidence. This study aimed to fill this gap by comparing Canine Behavioural Assessment and Research Questionnaire (C-BARQ) scores between the three most common designer-crossbreeds in the UK and their relevant progenitor breeds. C-BARQ behaviour data for all 12 sub-scales were collected in March 2023 via an online questionnaire of owners of Cockapoo, Labradoodle, Cavapoo, Cocker Spaniel, Labrador Retriever, Cavalier King Charles Spaniel and Poodle dogs acquired aged ≤16 weeks from 1st January 2019. C-BARQ scores were analysed using multivariable linear modelling. Valid responses were received representing 9,402 dogs. From 72 behavioural comparisons overall (3 designer-crossbreeds x 2 progenitors x 12 C-BARQ scales), designer-crossbreeds overall exhibited more undesirable behaviours than a progenitor breed in 44.4% comparisons and fewer undesirable behaviours in 9.7% comparisons, with no differences detected for the remaining 45.8%. Cockapoos displayed the most undesirable behaviours of the three designer crossbreeds, and differed from Cocker Spaniels and Poodles in 16/24 comparisons, scoring worse for all 16. Cavapoos differed from Cavalier King Charles Spaniels and Poodles in 12/24 comparisons, scoring worse in 11. In contrast, Labradoodles differed from Labrador Retrievers and Poodles in 11/24 comparisons, scoring worse than their progenitors in five behaviours, but better in six. These findings suggest notable behavioural differences between designer-crossbreeds versus their progenitor breeds, with Cockapoos and Cavapoos in particular scoring worse. Wider awareness by prospective owners of these potential issues around undesirable behavioural traits could avoid misbelief-driven acquisitions (e.g., designer-crossbreeds require minimal training, or are particularly suited to households with children) that risk public health (e.g., elevated dog bite risks) and relinquishment due to unmet expectations.

Introduction

Over the past decade, the UK canine population has experienced sizeable demographic shifts towards an emerging dog type known as 'designer-crossbreeds', i.e., first or later generations of deliberate cross-breeding between two or more existing pure breeds to create new 'hybrid' breeds. Many of the most popular designer-crossbreed canines are Poodle crosses, with the Cockapoo (Cocker Spaniel x Poodle) already in the top three most popular puppy breeds (pure or designer-crossbreeds) to own in the UK in 2019 [1], and then rising further in demand in the UK during the COVID-19 pandemic [2]. Previous research has identified factors including perceived enhanced health, ease of training and hypoallergenicity as motivators towards acquiring designer-crossbreed dogs rather than purebred dogs [1].

However, despite rapidly rising public demand for certain designer-crossbreed dogs, there is currently very little published research reporting their behaviour, even though breed-associated behaviours (actual or perceived) are a key factor influencing breed choice during pre-purchase decision-making [3,4]. Consequently, during pre-purchase research, prospective owners considering whether to acquire a specific designer-crossbreed are forced to rely on anecdotal information. Domestic dogs are reported to show considerable diversity in behaviour both within and between breeds [5]. Owners often seek out a breed they believe will suit their lifestyle and personalities, and behaviour-related perceptions are identified as a strong motivator of designer-crossbreed acquisition [1,6]. Owners of UK designer-crossbreed dogs (not just limited to Poodle-crosses) were more likely to seek a breed that they perceived as easy to train and/or suitable with children, compared to purebred breed owners [1]. Similarly, a US study of just Poodle-crosses reported that the assumption that a breed of dog was 'good with children' or a 'good companion breed' more highly influenced Poodle-cross owners when making their breed-choice compared to non- Poodle-cross owners (purebred and mixed breed owners), and owners of their purebred progenitor breeds specifically [6].

A key factor for sustained dog ownership and owner satisfaction is a tight match between owners' expectations of their future breed/crossbreed's behaviour before acquisition and the reality of ownership following acquisition. When prior expectations are partially or fully unmet, the dog-owner bond can be significantly impaired and make for a more challenging ownership experience, and even potential relinquishment or euthanasia [7]. Specifically, beliefs around certain breeds being predictably 'good' or 'safe' with children puts public health at risk, e.g., via increased paediatric bite risk when this expectation is not met, or when owners consequently fail to engage in appropriate safeguarding of children around dogs [8] or in appropriate dog training. In mitigation, better evidence on the scale of undesirable behaviours in designer-crossbreeds is urgently needed to support appropriate evidence-based acquisition and behavioural husbandry by owners, to promote good dog-owner relationships, to support dog welfare (e.g., by meeting their behavioural needs), and to maximise the safety and wellbeing of all human members of households with dogs. Throughout this paper, the use of "undesirable behaviour" will refer to any canine behaviour that the owners of a dog perceive as problematic or troublesome [9].

Early work exploring behavioural comparisons between non-designer-crossbreeds (i.e., general crossbreed dogs) compared to purebred dogs suggested these non-specific crossbreeds were more likely to display undesirable behaviours compared to purebred breeds [10,11]. However, to date, there have been minimal behavioural comparisons between designer-crossbreeds and their progenitor breeds. Current understanding of behavioural genetics would suggest that the expression of particular behavioural traits in designer-crossbreeds would fall intermediately between the level of expression of each progenitor breed [12]. However, there is little published research supporting such a 'regression to the mean' theory in designer-crossbreeds. A recent study investigating undesirable behaviour expression in US designer-crossbreeds compared Goldendoodles and Labradoodles with their corresponding progenitor breeds: Golden Retriever, Labrador Retriever and either the Standard or Miniature Poodle [13].

That study used the Canine Behavioural Assessment and Research Questionnaire (C-BARQ), a validated and standardised behavioural tool, to compare fourteen different behavioural features [14]. Goldendoodles exhibited significantly more undesirable behaviours (i.e., higher C-BARQ scores for subscales where higher = less desirable behaviour) than the Poodle for two of the 14 C-BARQ traits: dog-directed aggression and dog-directed fear, and significantly more undesirable behaviour compared to Golden Retrievers for one trait, stranger-directed fear. In contrast, the Labradoodle exhibited significantly less undesirable behaviour than the Poodle for one trait, dog rivalry [14].

These differences may reflect a combination of effects that include the varying genetics of designer crossbreeds compared to their progenitor breeds ('nature') and may also reflect differences in dog ownership profiles and style between designer crossbred and purebred dog owners ('nurture'), or underlying differences in their interpretation and scoring of behaviour. In the ten other C-BARQ behaviour categories, Labradoodles scored intermediately between their progenitor breeds, somewhat supporting regression to the mean for designer-crossbreed expression of undesirable behavioural traits to levels midway between the progenitor breeds.

The Goldendoodle was also reported to express most behaviours studied at an intermediate level between the purebred progenitors, but the Goldendoodle varied from its progenitors more often compared to the Labradoodle. Consequently, these results suggest that behavioural profiles differ between distinct Poodle-crosses despite sharing half of the same parentage, and even when their non-Poodle progenitor is a similar breed (i.e., both progenitors were Retriever types in that study). This suggests that each distinct designer-crossbreed should be considered as a unique breed, and consequently requires the generation of its own unique evidence base. Further research utilising the C-BARQ to compare behaviour between designer-crossbreeds and their progenitors is needed to add evidence on the behavioural status of other popular Poodle-cross designer-crossbreeds, particularly in light of the rapidly rising popularity of Cockapoos and Cavapoos in the UK.There is limited evidence regarding the inheritance of the two behavioural traits commonly perceived as desirable attributes of designer-crossbreeds, i.e., ease of training and suitability with children. The limited evidence that can be derived from studies of animals bred

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as working guide dogs, who are commonly intentional crosses between distinct pure breeds, is mixed. Training results from The Seeing Eye Guide Dog School (US) reported that Labrador Retriever x Golden Retriever cross dogs (also known as Goldadors) had a higher probability for completing training and graduating as guide dogs compared to their purebred progenitors [15]. In contrast, a questionnaire-based study assessing international guide dog puppy training identified Labrador Retriever x Golden Retriever cross dogs to have a reduced success rate in training compared to other purebred breeds [16]. Those authors proposed that crossbreeding may result in a greater diversity of behaviour and, therefore, a poorer success rate for outcomes that require consistent behavioural patterns across dogs.

Companion animal-related commercial organisations often cite a good temperament of many Poodle-crosses as a reason for recommending these dogs for homes with children [17–19], and in a previous questionnaire-based study, 41.6% of designer-crossbreeds were reported to live in households with children, compared to just 31.2% of purebreds [1].

However, no data on actual interactions between designer-crossbreeds and children have been published to date to support claims of higher suitability of designer-crossbreed behaviour for family homes compared to other breeds. Additional research is required to investigate the prevalence and characteristics of undesirable behaviours in designer-crossbreeds, and particularly behaviours that could pose a risk to children, e.g., human-directed aggression.

Given the rising ownership of certain designer-crossbreeds despite a very limited evidence base on their behaviours, the current study aimed to explore UK owner-reported undesirable behaviours in the three most popular Poodle-cross designer-crossbreeds (Cockapoos, Labradoodles and Cavapoos) and compare this to their relevant purebred progenitor breeds. The study objectives were to quantify and compare the expression of undesirable behaviours reported by UK owners in dogs aged up to five years between three designer-crossbreeds (Cockapoo, Labradoodle and Cavapoo) and each of their two relevant progenitor breeds (CKCS, Cocker Spaniel, Labrador Retriever and Miniature Poodle, Standard Poodle or Toy Poodle) using a validated, standardised canine behaviour questionnaire (C-BARQ). The study hypothesised that Cockapoo, Labradoodle and Cavapoo score intermediately in behavioural expression on all C-BARQ scales between their relevant progenitor breeds.

Materials and methods

An online survey was used to explore ownership experiences for three selected designer-crossbreeds (Cockapoo, Labradoodle and Cavapoo) and their relevant progenitor purebred breeds (CKCS, Cocker Spaniel, Labrador Retriever and Miniature Poodle, Standard Poodle or Toy Poodle). The questionnaire included questions related to the dog's health (reported elsewhere [20]), husbandry and behaviour, but only the behavioural data are analysed and reported here. The questionnaire was hosted using Research Electronic Data Capture (REDCap) software [21] and was open from 21st February 2023 to 21st April 2023. Respondents typically took 20–25 minutes to complete the questionnaire. The study received ethical approval from the Social Science Research Ethical Review Board at the Royal Veterinary College (URN SR2022–0184). Respondents gave written consent before starting the questionnaire. Respondents could exit the survey at any time, but because the survey was anonymous, respondents could not withdraw their response once submitted.

Survey recruitment

Respondents were recruited by multiple pathways [1]. Digital posters for individual designer-crossbreeds and purebred progenitor breeds (S1 File) were created and shared by the authors via snowball sampling on breed-specific pages on social media sites (e.g., Facebook, Instagram, Reddit and X). Large UK animal charities, namely Blue Cross, RSPCA, and PDSA, veterinary-specific organisations (e.g., VetPartners Ltd), and other organisations from the veterinary and welfare sectors (e.g., PetPlan, Pets at Home, Agria and APDAWG) promoted the questionnaire on their social media platforms. The pet classifieds site, Pets4Homes, shared the questionnaire link by direct email to users who had shown an interest in purchasing any of the study breeds/crossbreeds in the 600 days before the survey launch. The UK Kennel Club promoted the questionnaire via their registered breeders for the six purebred breeds. Finally, the authors distributed breed-specific flyers in person at Crufts 2023, Birmingham. A complete list of disseminators is shown in the Acknowledgements section.

Inclusion criteria

Respondents were required to be aged 18 years or over, resident in the UK and to currently own at least one designer-crossbreed from a specified list of Poodle crosses [Cockapoo (Cocker Spaniel crossed with a Poodle), Cavapoo (CKCS crossed with a Poodle), Labradoodle (Labrador Retriever crossed with a Poodle)] or a purebred dog of a progenitor breed of the aforementioned designer-crossbreeds [CKCS, Cocker Spaniel, Labrador Retriever, Miniature Poodle, Standard Poodle or Toy Poodle]. The three designer-crossbreeds were chosen as the most numerous designer-crossbreeds in VetCompass in the UK, to maximise the relevance and statistical power of the study results [22].

Study dogs were required to have been acquired aged 16 weeks or younger from 1st January 2019 onwards. This ensured all study dogs were aged under 5 years old at completion of the questionnaire to reduce age confounding effects on health [23,24] and behaviour (e.g., avoiding geriatric-onset behavioural problems [25]), given that the wider designer-crossbreed population is likely to be younger on average than their purebred counterparts owing to the recent popularity spike in designer-crossbreed dogs.

As undesirable behaviours are most commonly reported in dogs under three years old [26], this age range aimed to still capture the expression of many undesirable behaviours in the general population. Respondents with more than one eligible dog were asked to complete the questionnaire for their dog named first alphabetically.

Survey content

The sections of the questionnaire relevant to the current study included:

1. The first section captured owner demographics, including age, gender, postcode and occupation, and canine demographics, including breed, sex, date of birth and their generation (if the dog was a crossbreed).
2. To collect data on dog behaviour, the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) [14] was used to explore six broad aspects of dog behaviour: training and obedience, aggression, fear and anxiety, separation-related behaviour, excitability, and attachment and attention-seeking. C-BARQ is a well-established tool that includes 73 questions, which are aggregated during analysis into 12 numerical subscales within the C-BARQ$^{(100)}$ scoring method [5]. To limit the length of the survey and to reduce response drop-out, questions under the 'miscellaneous problem behaviours' category of the original C-BARQ survey were omitted. These items have previously been shown to be optional and removable from the questionnaire without compromising the reliability or validity of the remaining subscales [1].
3. To quantify which (if any) resources were used by the owner to help with dog behaviour and training, and whether the owner had ever sought professional advice for their dog's behaviour, further questions were either adapted from previous surveys published by the current research group [2,27,28] or were newly curated by the same team. These questions were presented as single-choice or multiple-choice with an additional option for free-text responses.
4. To explore the difference between owners' expectations of behaviour and training before acquisition compared to the reality after acquisition of their dog, two additional multiple-choice questions were included with an option for free-text responses to expand upon their answers.

The full study questionnaire also included questions regarding the dog's health and husbandry that are not reported here. The full questionnaire can be found in the S2 File.

Data analysis

The questionnaire data were manually cleaned in Microsoft Excel (2013). Respondents were excluded if their responses did not show that they met all of the inclusion criteria. Statistical analysis used IBM SPSS Statistics (V29.0.0.0) software. Responses were combined to represent all three Poodle-type breeds (Toy, Miniature and Standard) as one Poodle group for analysis purposes, to maximise statistical power for comparisons [1].

Descriptive statistics reported frequency and percentage for relevant variables. Median, range and interquartile range (IQR) of dog age (years) were calculated at the date of completion of the questionnaire. Other demographic variables were compared between designer-crossbreeds and their progenitors using chi-square testing.

Analysis of variance (ANOVA) was used to compare mean breed scores for each of the 12 C-BARQ subscales. The two-way ANOVA models included a fixed set of additional variables to account for confounding that were selected using an information theory approach [29] developed from other canine welfare studies. The following were included as confounding factors [30,31]: dog age, sex and neuter status, owner gender and age, whether the puppy had been seen with the mother on day of collection (as a proxy of illegal sales [27]), whether the owner worked in the canine sector (given potentially differing experience levels/perceptions of behaviour), whether the respondents was the primary dog owner, first-time ownership and health disorder prevalence (given the emerging relationship between health and behaviour [32] using VetCompass coding [33]. The *p*-value for statistical significance for all analyses was set at $p < 0.05$.

Results

From $n = 10,524$ responses received, $n = 1,113$ (10.6%) did not meet all the inclusion criteria, and $n = 9$ (0.1%) had missing data for some of the inclusion criteria, leaving 9,402 (89.3%) valid responses that met all the inclusion criteria and were included in the final analytic dataset.

Dog demographics

The $n = 9,402$ dogs in the final analysis included $n = 3,424$ (36.4%) designer-crossbreed and $n = 5,978$ (63.6%) purebred dogs. The designer-crossbreed dog group comprised of $n = 1,856$ (19.7% of 9,402 dogs) Cockapoos, $n = 583$ (6.2%) Labradoodles and $n = 985$ (10.5%) Cavapoos. The purebred dog group comprised of $n = 715$ (7.6%) CKCS, $n = 2,237$ (23.8%) Cocker Spaniels, $n = 2,099$ (22.3%) Labrador Retrievers, $n = 352$ (3.7%) Miniature Poodles, $n = 315$ (3.4%) Standard Poodles and $n = 260$ (2.8%) Toy Poodles, with the three Poodle breeds combined represented by $n = 927$ dogs (9.9%).

All dogs included in the study were required to be 5 years old or under. The overall median age of all dogs in the study was 22 months (IQR: 12–34, range: 9–56). Designer-crossbreeds were significantly younger than purebred breeds ($p < 0.001$), with the median age of dogs within the designer-crossbreed group being 19 months (IQR: 10–31, range: 1–55), while the median age of dogs in the purebred breed group was 24 months (IQR:13–32, range: 1–56). Of the designer-crossbreeds with data available, $n = 1,899$ (20.2%) were reported as F1 generation (first-generation cross between two purebred progenitor breeds), $n = 225$ (2.4%) F2 generation, $n = 32$ (0.3%) F3 generation and $n = 143$ (1.5%) multigenerational.

The full details of designer-crossbreed generation can be found in Table 1. An F1 ($n = 1,899$, 20.2%) was the most commonly reported generational type overall across all three designer-crossbreeds. Labradoodles were significantly less likely to be reported as F1 compared to the other two designer-crossbreeds (F1: Cockapoo: $n = 1,103$, 59.7%; Cavapoo: $n = 600$, 61.3%; Labradoodle: $n = 196$, 33.8%; $p < 0.001$). A total of $n = 154$ (1.6%) owners reported they did not know their dog's generation, and the generation of $n = 365$ (3.9%) designer-crossbreeds was unspecified.

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Of the *n* = 3,424 Poodle-cross designer-crossbreeds, *n* = 3,059 had information on their dog's specific type of Poodle progenitor breed. Of these, Miniature Poodles (*n* = 1,749, 57.2%) were the most represented progenitor Poodle breed. Compared to the other two designer-crossbreeds, Cockapoos were most likely to include a Miniature Poodle progenitor (Cockapoo: *n* = 1,031, 55.8%; Cavapoo: *n* = 467, 47.7%; Labradoodle: *n* = 251, 44.1%; $p < 0.001$). Toy Poodles (884, 28.9%) were the second most represented progenitor Poodle type in the sample. Of the three designer-crossbreed types, Cavapoos were the most likely to include a Toy Poodle progenitor (Cavapoo: *n* = 406, 41.5%; Cockapoo:

n = 442, 23.9%; Labradoodle: *n* = 36, 6.3%; $p < 0.001$). Standard Poodles (*n* = 426, 13.9%) were the least commonly represented Poodle progenitor in the sample. Of the three designer-crossbreed types, Labradoodles were the most likely to include a Standard Poodle progenitor (Labradoodle: *n* = 228, 40.1%; Cockapoo: *n* = 163, 8.8%; Cavapoo: *n* = 35, 3.6%; $p < 0.001$).
The overall study population included *n* = 4,373 (46.5%) male and *n* = 4,287 (45.6%) female dogs; the sex of *n* = 742 (7.9%) dogs was unspecified. Designer-crossbreeds were significantly more likely to be female than purebred dogs (designer-crossbreed: female *n* = 1,638, 51.3%, male: *n* = 1,558, 48.7%; purebred: female: *n* = 2,648, 48.5%, male:

n = 2,815, 51.5%; $p = 0.013$). Sex distribution did not statistically differ significantly between the three designer-crossbreeds (male: Cockapoo *n* = 870, 50.1%, Cavapoo *n* = 429, 46.9%, Labradoodle *n* = 259, 47.4%; $p = 0.237$). Canine demographic data for each dog breed and total frequencies can be found in S3 File.

Generation of Cross	Overall, for three Designer-crossbreeds No. (%)	Cockapoo No. (%)	Labradoodle No. (%)	Cavapoo No. (%)
F1 (e.g., their parents were a purebred Poodle (Toy/Miniature/Standard) and a purebred second breed (e.g., a Cavalier King Charles Spaniel, Cocker Spaniel, Labrador Retriever))	**1,899 (55.5%)**	**1103 (59.7%)**	**196 (33.8%)**	**600 (61.3%)**
F1B (e.g., their parents were an F1 cross and a purebred Poodle (Toy/Miniature/Labrador))	**605 (17.7%)**	**312 (16.9%)**	**103 (17.8%)**	**190 (19.4%)**
F1BB (e.g., Their parents were an F1B cross and a purebred Poodle (Toy/Miniature/Standard))	**43 (1.3%)**	**18 (1.0%)**	**16 (2.8%)**	**9 (0.9%)**
F2 (e.g., Their parents were both F1 crosses)	**225 (6.6%)**	**156 (8.4%)**	**38 (6.6%)**	**31 (3.2%)**
F2B (e.g., Their parents were an F2 cross and a purebred Poodle (Toy/ Miniature/Standard))	**69 (2.0%)**	**43 (2.3%)**	**18 (3.1%)**	**8 (0.8%)**
F2BB (e.g., Their parents were an F2B cross and a purebred Poodle (Toy/Miniature/Standard))	**11 (0.3%)**	**3 (0.2%)**	**7 (1.2%)**	**1 (0.1%)**
F3 (e.g., Their parents were both F2 crosses)	**32 (0.9%)**	**6 (0.3%)**	**21 (3.6%)**	**5 (0.5%)**
Multigeneration (e.g., their parents were both a cross of any generation beyond F3)	**143 (4.2%)**	**7 (0.4%)**	**131 (22.6%)**	**5 (0.5%)**
Unknown	**378 (11.0%)**	**199 (10.8%)**	**50 (8.6%)**	**129 (13.2%)**

Table 1. Frequency of generation types for Cockapoo (n = 1,847), Labradoodle (n = 580) and Cavapoo (n = 978) designer-crossbreeds in the UK

The overall study population included *n* = 4,785 (50.9%) entire dogs and *n* = 3,869 (41.1%) neutered dogs, while the neuter status of *n* = 748 (8.0%) dogs was unspecified. Designer-crossbreeds were more likely to be neutered than purebreds (designer-crossbreeds: *n* = 1,650 (51.6%), purebreds: *n* = 2,219 (40.6%); $p < 0.001$). Neuter status did not significantly differ between the three designer-crossbreeds (Cockapoo *n* = 909, 52.4%, Cavapoo *n* = 460, 50.2%, Labradoodle *n* = 281, 51.6%; $p = 0.558$).

Overall, *n* = 7,432 (79.0%) of the study population were insured, and *n* = 1,238 (13.2%) were uninsured. The insurance status of *n* = 732 (7.8%) dogs was unspecified. Designer-crossbreeds were more likely to be insured than purebreds (designer-crossbreeds *n* = 2,826 (82.5%), purebreds *n* = 4,606 (77.1%); $p < 0.001$). The probability of being insured did not statistically differ between the three designer-crossbreeds (insured: Cockapoo *n* = 1,535, 88.4%, Cavapoo *n* = 803, 87.6%, Labradoodle *n* = 489, 89.6%; $p = 0.516$).

In total, *n* = 6,697 (71.2%) of the study population saw the puppy's mother when they went to pick their puppy up, and *n* = 1,282 (13.6%) did not see the puppy's mother, with the remaining *n* = 1,423 (15.2%) unspecified. Designer-crossbreeds owners were significantly less

likely to see the puppy with its mother when they collected their puppy than purebred owners (designer-crossbreeds n = 2,415 (82.7%), purebreds n = 4,282 (84.6%); $p < 0.027$). The probability of seeing the puppy's mother at collection did not statistically differ between the owners of the three designer-crossbreeds (Cockapoo owners n = 1,319, 83.1%, Cavapoo n = 684, 83.1%, Labradoodle n = 412, 80.9%; $p = 0.501$). The overall median health disorder prevalence of all dogs in the study was two disorders (IQR: 1–3, range: 0–13). The median disorder prevalence did not significantly statistically differ between designer crossbreeds and their purebred progenitors (designer crossbreeds: IQR: 1–3, range: 0–13, median: 2.0; purebreds: IQR: 1–3, range: 0–12, median: 2.0, $p = 0.294$), nor did it significantly statistically differ between the three designer-crossbreeds (Cockapoo: IQR: 1–3, range, 0–11, median: 2.0; Cavapoo: IQR: 0–3, range: 0–9, median: 2.0; Labradoodle: IQR: 1–3, range: 0–13, median: 2.0; $p = 0.501$).

Owner demographics

From n = 10,524 responses received, n = 1,113 (10.6%) did not meet all the inclusion criteria, and n = 9 (0.1%) had missing data for some of the inclusion criteria, leaving 9,402 (89.3%) valid responses that met all the inclusion criteria in the final analytic dataset. Most respondents were female (n = 7,493, 79.7%), with n = 1,012 male (10.8%), n = 16 'other' (0.2%) and n = 28 (0.3%) selecting 'prefer not to say'. Compared to purebred dogs, designer-crossbreed owners were more likely to be female than male (designer-crossbreed female owners: n = 2,798, 88.7% vs. purebred female owners: n = 4,693, 87.0%, $p = 0.020$). The most represented age group among all respondents was 45–54 years old (23.5%), with no significant difference in owner age group between designer-crossbreed owners and purebred owners (for example, over 35 years: designer-crossbreed owners: n = 2,345, 76.0%; purebred owners: n = 4,019, 75.7%, $p = 0.562$). Overall, 60.5% (n = 5,132) of respondents were first-time dog owners, while the remaining 39.5% (n = 3,353) had previously owned a dog. Designer-crossbreed dogs were significantly more likely to belong to first-time dog owners compared to purebred dogs (designer-crossbreeds: n = 1,543, 49.6% vs. purebreds: n = 1,803, 33.7%, $p < 0.001$). Adult-only homes were the most common household structure (n = 4,864, 51.7%), although designer-crossbreeds were significantly more likely to live in households with children than purebred dogs (living with children: designer-crossbreeds: 36.6% vs. purebreds: 29.4%; $p < 0.001$). Almost 1 in 10 respondents (n = 810; 9.5%) worked in the canine/animal care sector, with owners of designer-crossbreed dogs significantly less likely to work in this sector compared to purebred owners (designer- crossbreeds: n = 153, 4.9% vs purebreds: n = 657, 12.1%; $p < 0.001$). Owner demographic data for each dog breed and total frequencies can be found in the S4 File.

C-BARQ behavioural comparisons.

A total of 72 C-BARQ behaviour scale comparisons were carried out: each of the 12 C-BARQ subscales was compared for each of the three designer-crossbreeds against their two relevant progenitor breeds (12 x 3 x 2 = 72). The full C-BARQ results for each breed can be found in the S5 File. After accounting for confounding in multivariable analyses, designer-crossbreeds overall differed significantly from a progenitor breed in 54.2% (n = 39/72) of behaviour scale score comparisons, with 41.7% (n = 30/72) showing higher and 12.5% (n = 9/72) showing lower behaviour scale scores. Except for trainability, higher scores equate to more undesirable behaviour. In contrast, higher trainability equates to less undesirable behaviour (i.e., higher trainability scores being taken as being more desirable); as such, results are reported as more or less undesirable behaviour to aid consistency of interpretation. Taking this into account, from 72 behavioural comparisons overall (3 designer-crossbreeds x 2 progenitors x 12 C-BARQ scales), designer-crossbreeds overall exhibited more undesirable behaviours than a progenitor breed in 44.4% (32/72) comparisons and fewer undesirable behaviours in 9.7% (7/32) comparisons, with no differences detected for the remaining 45.8% (33/72).

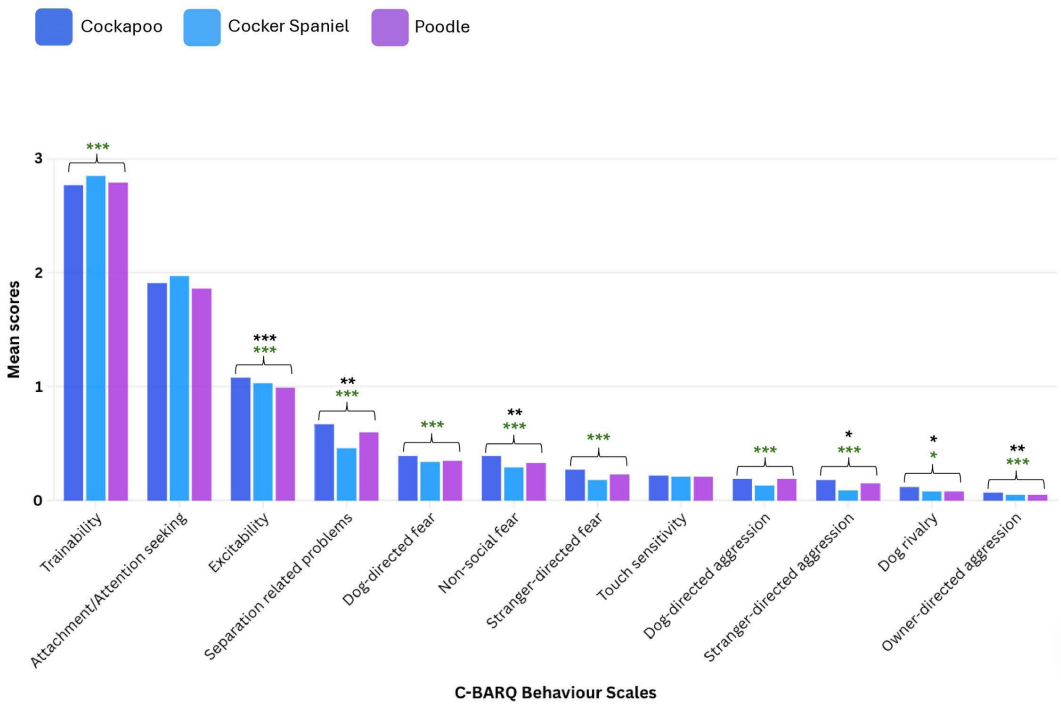


*Figure 1. The mean scores for each of the 12 C-BARQ behaviour scales for Cockapoos, Cocker Spaniels and Poodles. Significance is shown by stars: *p = 0.05-0.01, **p = 0.01-0.001, ***p < 0.001. Stars in green indicate a significant difference between the designer-crossbreed and non-Poodle progenitor behaviour comparison. Stars in black indicate a significant difference between the designer-crossbreed and Poodle progenitor behaviour comparison.*

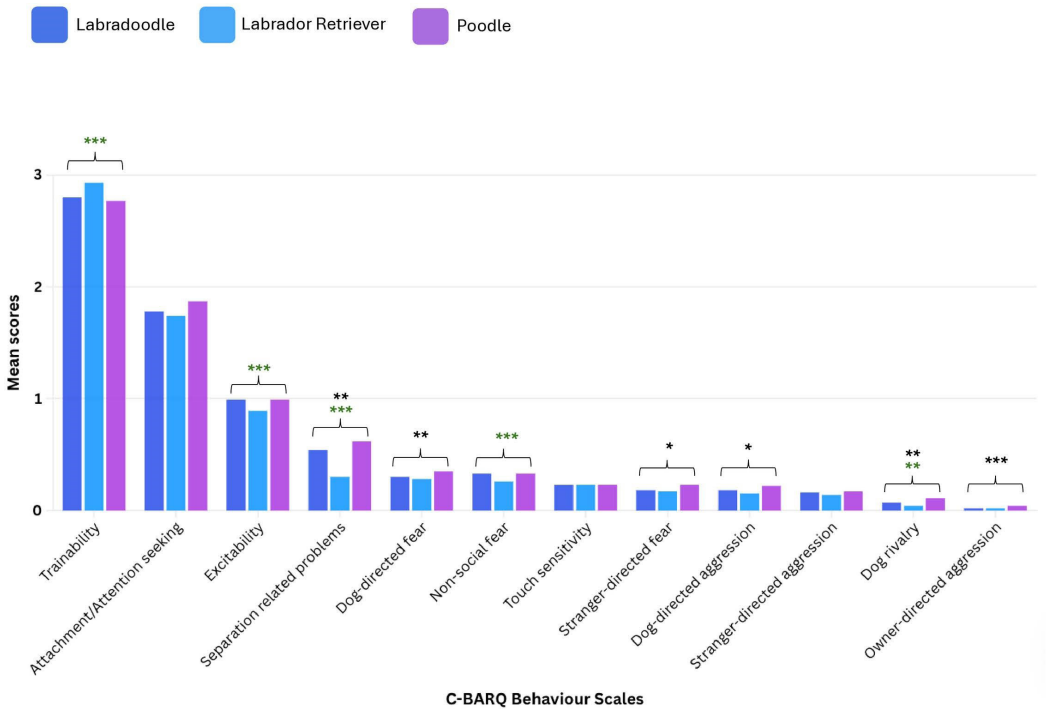


*Figure 2. The mean scores for each of the 12 C-BARQ behaviour scales for Labradoodles, Labrador Retrievers and Poodles. Significance is shown by stars: *p = 0.05-0.01, **p = 0.01-0.001, ***p < 0.001. Stars in green indicate a significant difference between the designer-crossbreed and non-Poodle progenitor behaviour comparison. Stars in black indicate a significant difference between the designer-crossbreed and Poodle progenitor behaviour comparison.*

Cockapoo vs. progenitor breeds.

Compared to their Poodle progenitor breed, Cockapoos differed in 6/12 (50.0%) of C-BARQ behaviour scales (Fig 1). Cockapoos scored significantly higher (i.e., exhibited more undesirable behaviour) in all six of these C-BARQ comparisons to Poodles: owner-directed aggression (p = 0.005), stranger-directed aggression (p = 0.017), dog rivalry (p = 0.024), non-social fear (p = 0.001), separation-related problems (p = 0.010) and excitability (p < 0.001). Compared to their Cocker Spaniel progenitor breed, Cockapoos differed in 10/12 (83.3%) of C-BARQ behaviour scales after accounting for confounding in multivariable analyses. Cockapoos exhibited significantly more undesirable behaviour for 10/10 differing C-BARQ comparisons to Cocker Spaniels: owner-directed aggression (p < 0.001), stranger-directed aggression (p < 0.001), dog-directed aggression (p < 0.001), dog rivalry (p = 0.032), stranger-directed fear (p < 0.001), non-social fear (p < 0.001), dog-directed fear (p < 0.001), separation-related problems (p < 0.001), excitability (p < 0.001) and trainability (p < 0.001). No significant difference was found between Cockapoos compared to either progenitor breed (Poodles and Cocker Spaniels) for two C-BARQ behaviour scales: touch sensitivity (Cockapoo vs. Poodle: p = 0.457; Cockapoo vs. Cocker Spaniel: p = 0.959) and attachment/attention-seeking (Cockapoo vs. Poodle: p = 0.635; Cockapoo vs. Cocker Spaniel: p = 0.418).

Labradoodle vs. progenitor breeds.

Compared to their Poodle progenitor breed, Labradoodles differed in 6/12 (50.0%) C-BARQ behaviour scales after accounting for confounding in multivariable analyses (Fig 2). Labradoodles exhibited significantly less undesirable behaviour in 6/6 of these C-BARQ behaviour scale comparisons to Poodles: owner-directed aggression (p < 0.001), dog-directed aggression (p = 0.025), dog rivalry (p = 0.007), stranger-directed fear (p = 0.032), dog-directed fear (p = 0.009) and separation-related problems (p = 0.008).

Compared to their Labrador Retriever progenitor breed, Labradoodles differed in 5/12 (41.7%) C-BARQ behaviour scales after accounting for confounding in multivariable analyses. Labradoodles exhibited significantly more undesirable behaviour for 5/5 differing C-BARQ scale comparisons to Labrador Retrievers: dog rivalry (p = 0.009), non-social fear (p < 0.001), separation-related problems (p < 0.001), excitability (p < 0.001) and trainability (p < 0.001). No significant difference was found between Labradoodles compared to either progenitor breed (Poodles and Labrador Retriever) for three C-BARQ behaviour scales: stranger-directed aggression (Labradoodle vs. Poodle: p = 0.364; Labradoodle vs Labrador Retriever: p = 0.086), touch sensitivity (Labradoodle vs. Poodle: p = 0.983; Labradoodle vs. Labrador Retriever: p = 0.652) and attachment/attention-seeking (Labradoodle vs. Poodle: p = 0.220; Labradoodle vs. Labrador Retriever: p = 0.456).

Cavapoo vs. progenitor breeds.

Compared to their Poodle progenitor breed, Cavapoos differed in 3/12 (25.0%) C-BARQ behaviour scales after accounting for confounding in multivariable analyses (Fig 3). Cavapoos exhibited significantly more undesirable behaviour for 3/3 differing C-BARQ comparisons to Poodles: non-social fear (p = 0.006), dog-directed fear (p = 0.027) and trainability (p = 0.006). Compared to their CKCS progenitor breed, Cavapoos differed in 9/12 (75.0%) C-BARQ behaviour scales after accounting for confounding in multivariable analyses. Cavapoos exhibited significantly more undesirable behaviours for 8/9 of the differing C-BARQ comparisons to CKCS: owner-directed aggression (p = 0.003), stranger-directed aggression (p < 0.001), dog-directed aggression (p < 0.001), stranger-directed fear (p = 0.002), non-social fear (p = 0.002), dog-directed fear (p = 0.003), separation-related problems (p < 0.001) and excitability (p < 0.001). Cavapoos exhibited significantly less undesirable behaviour for 1/9 of the differing C-BARQ comparisons to CKCS: trainability (p < 0.001).

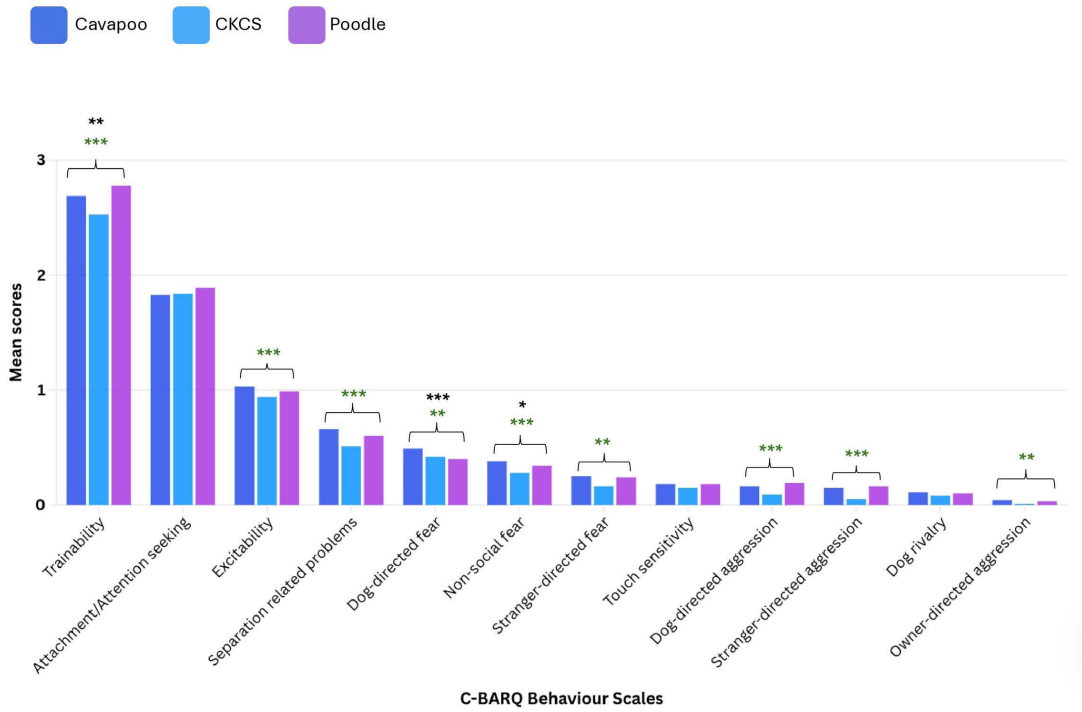


*Figure 3. The mean scores for each of the 12 C-BARQ behaviour scales for Cavapoos, Cavalier King Charles Spaniels and Poodles. Significance is shown by stars: *p = 0.05-0.01, **p = 0.01-0.001, ***p < 0.001. Stars in green indicate a significant difference between the designer-crossbreed and non-Poodle progenitor behaviour comparison. Stars in black indicate a significant difference between the designer-crossbreed and Poodle progenitor behaviour comparison.*

There was no significant difference between the Cavapoo compared to either progenitor breed (CKCS and Poodle) for C-BARQ scale scores for three behaviours: dog rivalry (Cavapoo vs. Poodle: p = 0.455; Cavapoo vs. CKCS: p = 0.085), touch sensitivity (Cavapoo vs. Poodle: p = 0.969; Cavapoo vs. CKCS: p = 0.118) and attachment/attention-seeking (Cavapoo vs. Poodle: p = 0.325; Cavapoo vs. CKCS: p = 0.860).

Behavioural professional advice: Overall, 17.2% (n = 1,072) of owners had sought advice from a behavioural professional regarding their dog's behaviour. Cockapoo owners (n = 243, 22.7%) did not statistically differ from Cocker Spaniel owners (n = 219, 20.4%,95% CI: 18.0–22.8) or Poodle owners (n = 105, 9.8%, 95% CI: 8.0–11.6, p = 0.137) in whether they had sought advice from a behavioural professional regarding their dog's behaviour. Labradoodle owners (n = 92, 8.6%) had higher odds for whether they had sought advice from a behavioural professional regarding their dog's behaviour than Poodle owners (n = 105, 9.8%, OR:1.44, 95% CI: 8.0–11.6, p = 0.022) but did not differ from Labrador Retrievers (n = 250, 23.3%, 95% CI: 20.8–25.8). Cavapoo owners (n = 104, 9.7%) did not statistically differ from CKCS owners (n = 59, 5.5%, 95% CI: 4.2–6.8) or Poodle owners (n = 105, 9.8%, 95% CI: 8.0–11.6, p = 0.939) in whether they had sought advice from a behavioural professional regarding their dog's behaviour.

Training methods: Overall, n = 1,126 (11.9%) owners used exclusively "rewards-only" methods of training, compared to n = 5,088 (53.8%) of owners who used both "reward and aversive" methods.

Compared to Poodle owners (rewards-only: n = 151, 13.4%; reward and aversive: n = 454, 8.9%), there was no significant difference in the methods of training used by Cockapoo owners (rewards-only: n = 279, 24.8%; reward and aversive: n = 941, 18.5%, p = 0.648). However, Cocker Spaniel owners (rewards-only: n = 200, 17.8%; reward and aversive: n = 1286, 25.3%) had higher odds of using "reward and aversive" based training methods than just "rewards-only" methods, compared to Cockapoo owners (OR:

Designer-Crossbreed	Progenitor Purebred	Multivariable*		
		Odds Ratio	95% CI	P value
Cockapoo	Poodle	0.95	0.74–1.20	p = 0.648
	Cocker Spaniel	1.98	1.61–2.45	p < 0.001
Labradoodle	Poodle	0.78	0.56–1.07	p = 0.127
	Labrador Retriever	1.87	1.37–2.56	p < 0.001
Cavapoo	Poodle	0.85	0.64–1.13	p = 0.267
	Cavalier King Charles Spaniel	0.81	0.60–1.09	p = 0.165

*Table 2. Multivariable logistic regression analysis results comparing the probability of designer-crossbreed owners using both reward and aversive-based training methods compared to the progenitor purebred owners. *Multivariable modelling also included age of dog, sex of dog, age of owner, owner gender, whether puppy had been seen with the mother on day of pick up, whether owner worked in the canine sector, primary dog ownership, and first-time ownership. Figures in red indicate p < 0.05.*

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1.98, 95% CI: 1.61–2.45, $p < 0.001$). Compared to Poodle owners, there was no significant difference in the methods of training used by Labradoodle owners (rewards-only: $n = 76$, 6.7%; rewards and aversive: $n = 319$, 6.3%, $p = 0.127$); however, Labrador Retriever owners (rewards-only: $n = 169$, 15.0%; reward and aversive: $n = 1,282$, 25.2%) had higher odds of using "reward and aversive" based training methods than "rewards-only" methods, compared to Labradoodle owners (OR: 1.87, 95% CI: 1.37–2.56, $p < 0.001$). Cavapoo owners (reward-only: 133, 11.8%; reward and aversive: $n = 475$, 9.3%) did not differ from either Poodle owners ($p = 0.267$) or CKCS owners (reward-only: 118, 10.5%; reward and aversive: $n = 328$, 6.4%, $p = 0.165$) in their use of training methods (Table 2).

General Training Advice / Resources: The most commonly used training advice/resources used overall were dog trainers ($n = 3,206$, 33.9%), talking to friends and family ($n = 2,662$, 28.2%), books ($n = 2,635$, 27.9%), social media ($n = 2,466$, 26.1%) and animal charity websites ($n = 1,881$, 19.9%) (Fig 4).

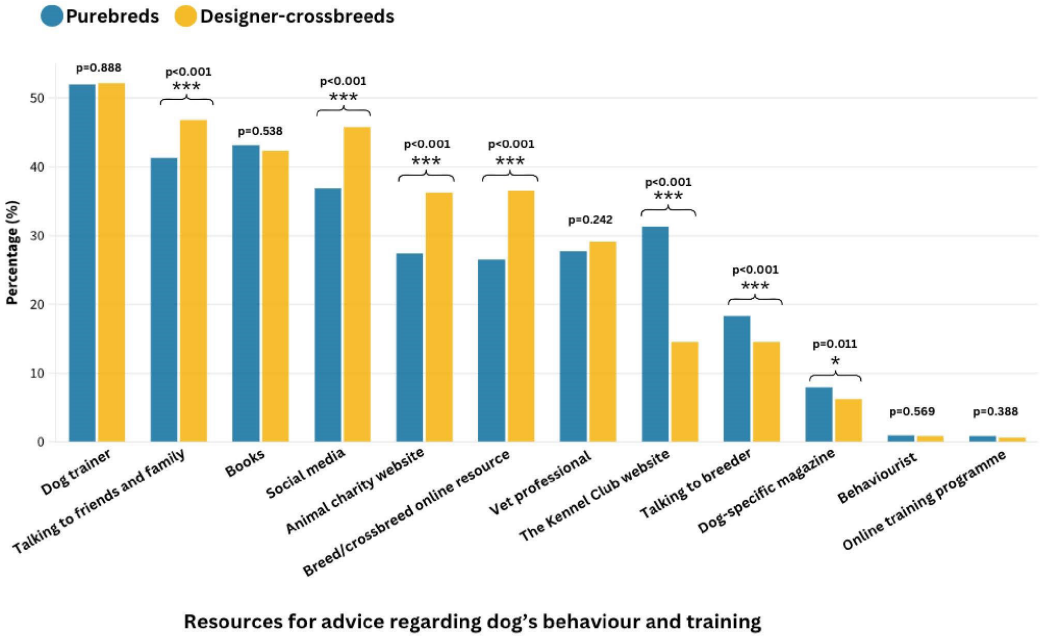


Figure 4. The percentage of designer-crossbreed owners compared to purebred owners who have ever used specific resource(s) for advice regarding their dog's behaviour and training.

Of the training advice and resources that significantly differed between designer-crossbreeds and their purebred progenitor breeds (Table 3), all purebred owners had higher odds of using The Kennel Club website as a training and behaviour resource, compared to designer-crossbreed owners (Poodle vs Cockapoo: OR: 3.09, 95% CI: 2.42–3.93, $p < 0.001$; Cocker Spaniel vs Cockapoo: OR: 2.99, 95% CI: 2.45–3.65, $p < 0.001$; Poodle vs Labradoodle: OR: 2.41, 95% CI: 1.75–3.31, $p < 0.001$; Labrador Retriever vs Labradoodle: OR: 2.33, 95% CI: 1.93–3.45, $p < 0.001$; Poodle vs Cavapoo:

OR: 2.33, 95% CI: 1.77–3.08, $p < 0.001$, CKCS vs Cavapoo: OR: 1.92, 95% CI: 1.42–2.60, $p < 0.001$).

Poodle owners had higher odds of using dog-specific magazines as a training and behaviour resource compared to Cavapoos (OR: 1.72, 95% CI: 1.06–2.82, $p = 0.030$), but no significant difference was found between the other designer-crossbreeds and their progenitor purebred breeds (CKCS vs Cavapoo: $p < 0.169$; Poodle vs Cockapoo: $p = 0.874$; Cocker Spaniel vs Cockapoo: $p = 0.667$; Poodle vs Labradoodle: $p = 0.068$; Labrador Retriever vs Labradoodle: $p = 0.430$).

Both Poodle and Cocker Spaniel owners had higher odds of using dog breeders as a training and behaviour resource, compared to Cockapoo owners (Poodle vs Cockapoo: OR:1.97, 95% CI: 1.53–2.53, $p < 0.001$; Cocker Spaniel vs Cockapoo: OR:1.28, 95% CI: 1.03–1.58, $p < 0.001$). Poodle owners had higher odds of using dog breeders as a training and behaviour resource compared to Labradoodle owners, but no significant difference was found between Labrador owners and Labradoodle owners (Poodle vs Labradoodle: OR: 1.40, 95% CI: 1.02–1.92, $p = 0.038$; Labrador Retriever vs Labradoodle: $p = 0.769$). Poodle owners had higher odds of using dog breeders as a training and behaviour resource compared to Cavapoo owners (Poodle vs Cavapoo: OR: 1.83, 95% CI: 1.36–2.46, $p < 0.001$), but no significant difference was found between CKCS owners and Cavapoo owners (CKCS vs Cavapoo: $p = 0.930$)

In contrast, all designer-crossbreed owners had higher odds of using an animal charity website as a training and behaviour resource compared to purebred owners (Poodle vs Cockapoo: OR:0.62, 95% CI: 0.50–0.78, $p < 0.001$; Cocker Spaniel vs Cockapoo: OR:0.73, 95% CI: 0.62–0.86, $p < 0.001$; Poodle vs Labradoodle: OR: 0.50, 95% CI: 0.38–0.65, $p < 0.001$; Labrador Retriever vs Labradoodle: OR: 0.56, 95% CI: 0.45–0.71, $p < 0.001$; Poodle vs Cavapoo: OR: 0.60, 95% CI: 0.46–0.76, $p < 0.001$; CKCS vs Cavapoo: OR: 0.76, 95% CI: 0.58–0.99, $p = 0.043$).

Aditionally, all designer-crossbreed owners had higher odds of using a breed/crossbreed specific online resource, as a training and behaviour resource, compared to purebred owners (Poodle vs Cockapoo: OR:0.60, 95% CI: 0.48–0.75, $p < 0.001$; Cocker Spaniel vs Cockapoo: OR:0.72, 95% CI: 0.61–0.85, $p < 0.001$; Poodle vs Labradoodle: OR: 0.51, 95% CI: 0.39–0.67, $p < 0.001$; Labrador Retriever vs Labradoodle: OR: 0.53, 95% CI: 0.42–0.66, $p < 0.001$; Poodle vs Cavapoo:

*Table 3. Multivariable logistic regression analysis results comparing the probability of designer-crossbreed owners using the seven most common types of training and behaviour resource/advice compared to the progenitor breed owners. Multivariable modelling also included age of dog, sex, age of owner, owner gender, whether puppy had been seen with the mother on day of pick up, whether owner worked in the canine sector, primary dog ownership, and first-time ownership. Red coloured cells denote purebred owners having higher odds of using that training resource, whereas blue coloured cells denote designer-crossbreed owners having higher odds at using that specific training resource. Figures in red indicate a statistically significant result. * OR odds ratio **CI confidence interval.*

Training and behaviour resource/ advice	Purebred progenitors vs Cockapoo						Purebred progenitors vs Labradoodle						Purebred progenitors vs Cavapoo					
	Poodle			Cocker Spaniel			Poodle			Labrador Retriever			Poodle			CKCS		
	OR*	Mean 95% CI**	P value	OR*	Mean 95% CI**	P value	OR*	Mean 95% CI**	P value	OR*	Mean 95% CI**	P value	OR*	Mean 95% CI**	P value	OR*	Mean 95% CI**	P value
The Kennel Club website	3.09	2.42-3.93	p<0.001	2.99	2.45-3.65	p<0.001	2.41	1.75-3.31	p<0.001	2.58	1.93-3.45	p<0.001	2.33	1.77-3.08	p<0.001	1.92	1.42-2.60	p<0.001
An animal charity website	0.62	0.50-0.78	p<0.001	0.73	0.62-0.86	p<0.001	0.50	0.38-0.65	p<0.001	0.56	0.45-0.71	p<0.001	0.60	0.46-0.76	p<0.001	0.76	0.58-0.99	p=0.043
A breed/ crossbreed-specific online resource	0.60	0.48-0.75	p<0.001	0.72	0.61-0.85	p<0.001	0.51	0.39-0.67	p<0.001	0.53	0.42-0.66	p<0.001	0.55	0.43-0.70	p<0.001	0.65	0.50-0.85	p=0.002
Social media sites	0.75	0.61-0.91	p=0.005	0.81	0.69-0.94	p=0.007	0.83	0.64-1.08	p=0.166	0.67	0.53-0.84	p<0.001	0.66	0.52-0.83	p<0.001	0.62	0.48-0.80	p<0.001
Dog-specific magazine	1.09	0.75-1.58	p=0.874	1.02	0.76-1.38	p=0.667	1.23	0.74-2.03	p=0.068	1.51	0.97-2.35	p=0.430	1.72	1.06-2.82	p=0.030	1.47	0.85-2.52	p=0.169
Talking to friends or family who own or have owned a dog	0.65	0.53-0.80	p<0.001	0.87	0.75-1.01	p=0.067	0.73	0.57-0.95	p=0.019	0.89	0.71-1.11	p=0.306	0.71	0.57-0.90	p=0.004	0.63	0.49-0.81	p<0.001
Talking to a dog-breeder	1.97	1.53-2.53	p<0.001	1.28	1.03 – 1.58	p<0.001	1.40	1.02-1.92	p=0.038	1.04	0.78-1.39	p=0.769	1.83	1.36-2.46	p<0.001	1.02	0.72-1.44	p=0.930

OR: 0.55, 95% CI: 0.43–0.70, $p < 0.001$; CKCS vs Cavapoo: OR: 0.65, 95% CI: 0.50–0.85, $p = 0.002$).

Cockapoo owners had higher odds of using social media sites as a training and behaviour resource compared to their progenitor breed owners (Poodle vs Cockapoo: OR:0.75, 95% CI: 0.61–0.91, $p = 0.005$; Cocker Spaniel vs Cockapoo: OR:0.81, 95% CI: 0.69–0.94, $p = 0.007$). Labradoodle owners had higher odds of using social media sites as a training and behaviour resource compared to Labrador Retrievers (Labrador Retriever vs Labradoodle: OR: 0.67, 95% CI: 0.53–0.84, $p < 0.001$), but no significant difference was found between Labradoodle and Poodle owners ($p = 0.166$). Cavapoo owners had higher odds of using social media sites as a training and behaviour resource compared to their progenitor breed owners (Poodle vs Cavapoo: OR: 0.66, 95% CI: 0.52–0.83, $p < 0.001$; CKCS vs Cavapoo: OR: 0.62, 95% CI: 0.48–0.80, $p < 0.001$).

Cockapoo owners had higher odds of talking to friends or family who own or have owned a dog as a training and behaviour resource compared to Poodle owners (Poodle vs Cockapoo: OR: 0.65, 95% CI: 0.53–0.80, $p < 0.001$), but no significant difference was found between Cockapoo owners and Cocker Spaniel owners ($p = 0.067$).

Labradoodle owners had higher odds of talking to friends or family who own or have owned a dog as a training and behaviour resource compared to Poodle owners (Poodle vs Labradoodle: OR: 0.73, 95% CI: 0.57–0.95, $p = 0.019$), but no significant difference was found between Labradoodle owners and Labrador Retriever owners ($p = 0.306$). Cavapoo owners had higher odds of talking to friends or family who own or have owned a dog as a training and behaviour resource compared to their progenitor breeds (Poodle vs Cavapoo: OR: 0.71, 95% CI: 0.57–0.90, $p = 0.004$; CKCS vs Cavapoo: OR: 0.63, 95% CI: 0.49–0.81, $p < 0.001$).

Discussion

This study identified several differences in the levels of undesirable behaviours in three specific designer-crossbreed breeds (Cockapoo, Labradoodle and Cavapoo) compared to their purebred progenitor breeds. Previous analyses of the same population of study dogs identified relatively few differences in physical health between the same three designer-crossbreeds compared to their progenitor breeds [1]. However, in sharp contrast, the three designer-crossbreeds overall differed in 54.2% (39/72) of behaviour comparisons to their progenitor breeds. Of the 39 comparisons that differed, designer-crossbreeds exhibited more undesirable behaviours in 82.1% (32/39) of behaviour

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scales compared and exhibited less undesirable behaviours in just 17.9% (7/39) of behaviour scales, despite perceived positive behavioural traits being a major driver of acquisition for designer crossbreed dogs [1]. Several patterns were notable in the behaviours that differed between the designer Poodle-crosses and the purebred parents. All three designer-crossbreed breeds exhibited significantly more non-social fear (e.g., fear of inanimate stimuli such as traffic, loud/sudden noises, novel objects/contexts), separation-related problems (e.g., undesirable behaviours such as excessive vocalisation and destructiveness when separated from their owner) and excitability (e.g., strong reactions to exciting/arousing events such as walks, car trips, doorbells and visitors) compared to their non-Poodle progenitors. Fear-related behaviours represent potentially serious welfare concerns that could reflect poorer emotional health in these dogs and could negatively impact the dog-owner bond [34] and owner wellbeing [35]. However, several earlier studies [36] have shown that remarkably few owners seek veterinary or other professional help or advice to manage these three important behavioural issues. A UK-based study investigating fear responses to noises in domestic dogs revealed that fewer than a third of dog owners sought professional advice regarding treating their dog's response to noises [37]. Owners of designer-crossbreeds should be mindful that displaying these behaviours likely indicates their dog is experiencing negative emotions such as fear, anxiety and/or panic, which should be prioritised with similar consideration as any physical ailment to maintain good welfare. Canine behaviourists and veterinary professionals can support designer- crossbreed owners by increasing awareness of the serious negative impacts of these undesirable behaviours upon their dogs and offer appropriate therapies to address them [38].

Behavioural variability between individual designer-crossbreed breeds

There was considerable variability in the levels of undesirable behaviours shown between the three designer-crossbreed breeds. This suggests that designer-crossbred dogs should not be considered as a homogeneous group from a behavioural perspective. Cockapoos displayed the most undesirable behaviours of the three designer-crossbreeds studied (compared to the purebred progenitors). When compared to Cocker Spaniels and Poodles (2 x 12 C-BARQ behaviours), Cockapoos differed in 16/24 behaviour scale comparisons, exhibiting more undesirable behaviour in all 16 comparisons. Cavapoos differed in 12/24 behavioural scale comparisons (2 x 12 C-BARQ behaviours), exhibiting more undesirable behaviour for 11/12 differing comparisons. In contrast, Labradoodles differed in 11/24 behaviour scale comparisons (2 x 12 C-BARQ behaviours) but only displayed more undesirable behaviour than their progenitors in five comparisons, while exhibiting less undesirable behaviour in six comparisons. Except for better trainability in Cavapoos compared to one of its progenitor breeds (the CKCS), the Labradoodle was the only designer-crossbreed to show less undesirable behaviour than its purebred parents in ≥ 1 behaviour scale. Consequently, from these results, it is evident that each new designer- crossbreed needs its own evidence base and extrapolating information from other designer-crossbreeds should be done with caution.

The results of the current study offer little support for the study hypothesis that specific Poodle-crosses score intermediately for all C-BARQ scales compared to their relevant progenitor breeds. That study hypothesis was based on an earlier C-BARQ analysis, which reported that Labradoodles scored intermediately between their parent breeds, the Poodle and Labrador Retriever [13]. Instead, our results suggest that the behaviour of this emerging designer Poodle- crossbreed demographic is generally worse than that of their progenitor breeds. However, in the current study, it was evident that Labradoodles differed less in the undesirable behaviour comparisons with their purebred progenitors, unlike the other designer-crossbreeds. This somewhat supports the findings of Shouldice et al (2019) in Labradoodles and highlights the importance of acknowledging disparity between designer-crossbreed breeds rather than expecting all Poodle-crosses to exhibit the same behaviours.

Factors influencing behavioural differences between designer crossbreeds and purebred progenitors

The reasons behind this disparity between Labradoodles and the other two smaller designer-crossbreeds are not clear, but one possibility is that Labradoodles were established earlier than Cockapoos and Cavapoos (as evidenced by the lowest level of F1 crosses in this study) and have undergone more generations of selection towards more desirable behavioural phenotypes than the other two designer crossbreeds. The impact of genetic inheritance of certain behaviours should be further considered. For example, studies exploring the presence of Insulin-like Growth Factor-1 (IGF1) in smaller-sized dog breeds suggest that the IGF-1 gene may have pleiotropic effects in miniature and toy dog breeds, causing these dog types to display more fearful, excitable or reactive behaviours [10,39,40]. The Cockapoo and Cavapoo are physically smaller-sized dogs owing to their Poodle progenitor being more likely to have been the Toy or Miniature Poodle (e.g., 41.50% of Cavapoos in the current study had Toy Poodle parentage), with serum levels of IGF-1 protein found to correlate with body size in Toy, Miniature and Standard Poodles [39]. This could partly explain why the Cockapoo and Cavapoo display more undesirable behaviours compared to the Labradoodle, as a larger designer-crossbreed. Size is an influential factor in undesirable behaviour, with previous studies finding that small dogs were twice as likely to show human-directed aggression compared to large dogs, with 30.8% of small dogs exhibiting this behaviour compared to 14.5% of large dogs and 19.4% of medium dogs [40]. That same study found that small (23.1%) and medium (25.8%) size dogs more commonly exhibited aggression toward objects in motion compared with large dogs (10.8%). Other owner-reported studies have similarly reported small dogs to be rated as more disobedient, more excitable and more nervous by their owners [10,41]. A correlation between small dog size and higher levels of undesirable behaviours could also reflect environmental influences, given that behaviour is a multifactorial trait and that owners are reported to interact differently with smaller versus larger dogs. For example, small dogs have been reported to receive less formal training than large dogs [41,42] and are walked less frequently [43]. In addition, owners of smaller dogs have been

reported to be more inconsistent in interactions with their dog and engage less in training and play activities than owners of larger dogs [43]. Responses to owners may also differ based on dog size, with increased anxiety and fear found to be associated with more frequent use of punishment in smaller dogs but not in larger dogs [43].

Given that small-sized dog breeds have been growing in popularity in the past decade [44,45], with new Poodle-cross breeds such as Cavapoos being a large contributor to this trend [2], it is possible that the prevalence of undesirable behaviours in the overall dog population could also increase.

Results from the current study are particularly important when considering the varying roles in which smaller designer-crossbreed dog types are commonly used. In recent years, the use of designer-crossbreeds as therapy dogs has grown, especially with neurodivergent children who may interact intensively with their dogs. Cavapoos make up 16.6% of dogs used by 'Dogs for Autism', a registered charity providing Autism Assistance dogs in the UK [46].

If, as this study's results suggest, Cavapoos demonstrate higher levels of aggressive behaviours than the CKCS, their appropriateness in such roles, as well as their role as a companion animal with children in general, given their high representation in such homes [1], may need to be reconsidered.

Cockapoo behavioural profile

Cockapoos were reported to display considerably more undesirable behaviours in comparison to their progenitor breeds in the current study than Cavapoos and Labradoodles. Cockapoos scored significantly higher than both purebred progenitors in aggression-related behaviours, including owner-directed aggression, stranger-directed aggression and dog rivalry. One explanation for this disparity could be a differential effect of the Cocker Spaniel parentage in the Cockapoo compared to the Cavalier King Charles Spaniel parentage in the Cavapoo. There have been numerous studies documenting the prevalence of aggressive behaviours in Cocker Spaniels (often termed "Cocker Rage"), particularly Golden Cocker Spaniels [47–49]. The combination of being a smaller breed and Cocker Spaniel parentage could explain why Cockapoos display an exacerbated level of aggression-related behaviours compared to their progenitors and other Poodle-mix designer-crossbreeds.

Furthermore, although both Labrador Retrievers and Cocker Spaniels are from the gun dog group, the differing roles for which they were originally bred could impact their overall temperament. Labrador Retrievers, as the name suggests, were originally bred to retrieve game and therefore to work closely with their handler, staying still and alert until released. Anecdotally, retrieving breeds have transitioned from field working roles to domestic companion roles more easily than spaniel breeds [50]; however, empirical research is needed to confirm this. Limited data suggest differences in impulsivity between show and working line Labrador Retrievers [51,52]. It is unknown whether any of the Labrador Retriever progenitors of the Labradoodles in this study, or the purebred Labrador Retrievers, were from working or show lines.

Future research could explore differences in Labradoodles derived from each line to evaluate which are more suitable for companion homes and show lower levels of undesirable behaviours. In contrast, the Cocker Spaniel breed was developed to flush out game from dense areas of woodland and grassland, and therefore required high-energy levels, mental resilience and intelligence. The result is a breed that is anecdotally described as an "interesting mixture of brains, energy, speed and independence", which can be "more of a problem in pet homes" [53]. When bred with a Poodle, these behavioural tendencies, combined with the smaller resultant crossbred offspring, could potentially result in more undesirable behaviours.

Consolidating the current study's findings regarding Cockapoo behaviour, the responses also revealed that a higher percentage of Cockapoo owners sought professional behavioural advice compared to Labradoodle and Cavapoo owners. Indeed, Cockapoo owners were the second most likely of all six breeds involved in the study to seek professional advice for their dog's behaviour (with Labrador owners being the most likely). This may imply that Cockapoos display a high level of undesirable behaviours which owners struggle to manage on their own and thus seek help to resolve. Until now, reports of undesirable behaviour in Cockapoos compared to other designer-crossbreeds have been predominantly anecdotal [54,55]. Undesirable behaviours are associated with a higher risk of relinquishment in dogs [56,57]. Spaniel Aid, a UK-based charity focused on rescuing and rehoming spaniels and spaniel-crosses, cite a lack of owner research as a main reason for relinquishment [58]. This risk of rehoming has the potential to increase if prospective owners continue to acquire breeds without informing and preparing themselves for likely behavioural traits. Spaniels and spaniel crosses are often advertised as a *"very good choice for first-time owners"* and can be *"easily trained"* [59–61], but the current findings refute these claims. Any owner interested in purchasing a Cockapoo should therefore now be aware that this breed may be predisposed to exhibiting aggressive behaviours.

Owner-reported behaviour

It is important to note that the behaviour data analysed in the current study were owner-reported. Human- centric factors have been found to influence each owner's perception of their dog's behaviour. An Australian study exploring owner interactions with companion dogs reported that dog owners believed crossbreds displayed more disobedient, nervous and excitable behaviours compared to purebreds [10]. To try to account for any such information biases, the multivariable statistical modelling used in the current study to analyse the C-BARQ data included several covariates to account for effects from human factors such as gender and ownership experience. For example, designer-crossbreeds were more likely to be owned by first-time owners compared to purebreds. First-time ownership has previously been reported as a risk factor for higher levels of owner-reported behavioural problems [10,42,62] and was also shown in the current study to have a significant association in numerous behaviour comparisons between designer-crossbreeds and purebreds. The current C-BARQ results revealed that first-time owners reported their dogs, regardless of breed type, had worse

trainability as well as higher separation-related problems and higher non-social fear scores. Additionally, the findings reveal that the owner's age and whether the respondent worked in the canine/animal care sector also had significant associations with C-BARQ scores, with younger owners reporting higher levels of dog-directed aggression and more serious separation-related problems, but also higher trainability scores. In contrast, respondents who worked in the canine/animal care sector reported lower touch sensitivity and lower social fear scores, consolidating previous research into canine behaviour that found an association with dogs displaying a lower level of undesirable behaviours and owners working in the canine sector [63].

Impact of health on behaviour

Overall disorder prevalence was the covariate with the greatest association within the ANOVA analysis of behaviour subscale scores. Overall disorder prevalence is a proxy summary metric for overall health, which is increasingly recognised as an important contributing factor towards higher undesirable behaviour scores in dogs, particularly disorders associated with stress and pain [64–70]. Large-scale empirical studies have reported statistical associations between the presence of specific health problems and undesirable behaviours.

For example, atopic dermatitis in dogs has been reported as associated with higher levels of undesirable behaviours such as excitability and reduced trainability [68], and anxiety and fear-driven behaviours [71]. Designer-crossbreeds in the current study cohort had higher odds of skin disorders such as atopic dermatitis and otitis externa than their progenitors [20], which may contribute to their elevated levels of undesirable behaviours. These associations between physical health problems and undesirable behaviours suggest that owners of designer-crossbreeds who perceive problematic behaviours in their dogs should first consider seeking veterinary advice to diagnose any underlying physical health conditions that could be contributing to their dog's behaviours.

Influence of provenance on behaviour

Another covariate that had notable associations with behaviour was whether the owner had seen the puppy with its mother on the day of collection, a proxy of illegal puppy sales in England under Lucy's Law [72]. Not seeing the mother during the collection of the puppy was linked to lower trainability scores in all comparisons between the designer-crossbreeds and their progenitor breeds. Additionally, not seeing the puppy's mother on collection of the puppy was associated with higher scores of owner- directed aggression and excitability in the Cockapoo and progenitor breed comparisons, higher separation-related problem scores in the Labradoodle and progenitor breed comparisons and higher dog rivalry scores in the Cavapoo and progenitor breed comparisons.

This reinforces previous results that indicate viewing a puppy without their mother is associated with a higher level of undesirable behaviour in the future [73].

The current study's results further consolidate earlier findings [1] that designer-crossbreed owners are less likely to see the mother of the puppy on the day of collection compared to purebred owners. By neglecting this key pre-purchasing behaviour, designer-crossbreed owners not only risk supporting the illegal puppy trade but also compromising their own dog's welfare.

Evidence suggests purchasing puppies from poor welfare sources has long-term negative behavioural and health outcomes, including for puppies purchased from pet shops [62,74,75], puppy farms [76], purchased without their mother and father present [73,77], or purchased underage [78]. All dog owners, especially designer-crossbreed owners, must therefore adhere to puppy purchasing guidance.

Gun dog behaviour and training

Cocker Spaniels and Labrador Retrievers are classified as gun dogs, one of the seven breed groups recognised by the UK Kennel Club [79]. Owners of both Cocker Spaniel and Labrador Retriever dogs were significantly more likely to use a combination of reward-and-aversive than reward-only based training methods compared to the Poodle and associated designer-crossbreed owners. The original role of gun dogs to locate and/or retrieve live game necessitated high levels of training. A major early training "guideline" (1952) for gun dogs was a book by Moxon (1952) ", Gundogs: Training and Field Trials" [80] that promoted methods that teach the dog "right" and "wrong" via the precise administration of physical punishment. While from the mid-20th century onwards, training of companion dogs more generally in the UK shifted to focus more on building relationships using reward-based methods, training cultures for gun dogs and working dogs have anecdotally remained focused on functionality and utility, perpetuating the use of aversive methods. This is despite aversive training methods (using positive punishment and negative reinforcement) having since been criticised for harming dog welfare and safety in the wider sector, e.g., [81,82], supported by scientific studies documenting negative welfare effects [83–86].

Both Labrador Retrievers and Cocker Spaniels in the current study scored better in trainability than their designer Poodle-crossbreed counterparts; however, while seemingly a positive result, this effect may result from forced suppression of 'disobedient' behaviours that can increase stress and cause a more negative mood state [86,87].

Many owners use aversive training techniques for perceived faster and more effective outcomes than positive reinforcement training methods [83]. However, research shows reward-based training is not only more effective than aversive training, but it can also help build a stronger dog-owner relationship and improve trust [83,84,88]. Consequently, owners of Cockapoos and Labradoodles (crossbreeds with gun dog parentage) should not interpret the finding of increased trainability in these breeds to suggest that aversive methods will help with their dog's training. Instead, owners are encouraged to seek professional and welfare-focused training guidance from either accredited dog behaviourists

or, if inaccessible (e.g., due to finances), consult reliable online resources, including animal welfare charities, e.g., Dogs Trust or Battersea Dogs and Cats Home, which provide free online training and behaviour resources that the public can readily access [89,90].

Professional behavioural advice

Designer-crossbreed owners had higher odds of using non-professional training and behaviour resources such as social media and information from family and friends than the owners of purebred dogs. These sources have the potential to be highly variable in quality and may be misleading [91]. Both designer-crossbreed owners and purebred owners were also found to use dog trainers as a common source for behaviour and training.

Dog training is currently unregulated in the UK, and therefore, there are no standards dog trainers have to adhere to [92], raising concerns over the training methods being promoted [93].

Dog owners are encouraged to seek professional advice regarding their dog's behaviour, such as from qualified behaviourists [94]. Furthermore, commonly accessed resources such as The Kennel Club should be encouraged to provide evidence-based information about the behaviour of designer-crossbreeds as well as purebred breeds, considering they are often only one or two generations away from the purebred breeds that they register.

Limitations

The current study had some limitations despite the steps taken to mitigate as many as possible. Although owner-reported surveys can offer large and well-powered studies, dog owners generally have a poorer understanding of canine behaviour compared to professionals and therefore, behaviour data reported by owners may be less reliable than data reported by qualified behaviourists [7]. The use of a standardised and validated canine behaviour tool, such as the C-BARQ, helped to mitigate differences in owner-reported data regarding dog behavioural traits. The convenience sampling methods used in the current study could have promoted some selection bias because owners who were offered the option to participate may not fully represent all dog owners. It is also possible that owners who responded to the current survey may be more welfare-conscious than the wider population of dog owners in the UK, resulting in a 'best-case scenario' representation for all breeds studied.

Similarly, owners who had previously encountered problems or behavioural issues with their dogs may have been more motivated to complete the survey questionnaire about their dog's behaviour and training. To minimise this selection bias, the current survey was promoted broadly across a range of social media platforms, including both breed-specific and non-breed-specific groups. It was also shared through diverse organisations with large followings and promoted in general pet or animal groups to reach a wider audience. In addition, the current paper focused on relative results between the breeds rather than on absolute values, with the assumption that respondent selection biases were likely to apply similarly across all the breeds.

The number of Poodles was relatively low in the study compared to the other purebred breeds. Consequently, the responses for each Poodle-type breed were combined and analysed as a collective rather than separately. However, the behaviour profiles of these three types of Poodles may differ, so this grouping process may have introduced bias between the results for the three designer-crossbreed breeds that were shown to differ in the different Poodle variant progenitors [5].

Additionally, it is important to note that the designer-crossbreeds involved in this study were Poodle-crosses, and consequently, the results may not apply to other designer-crossbreeds that do not have Poodle parentage.

Conclusions

The current study showed significant disparity in the behaviours exhibited between the three designer-crossbreeds studied and their purebred progenitors, with these three designer-crossbreeds overall showing more undesirable behaviours.

In particular, Cockapoos exhibited significantly more undesirable behaviours than the Labradoodle and Cavapoo designer-crossbreeds. The results of this study highlight the importance of owners thoroughly exploring the characteristics of any breed or crossbreed during pre-purchase research to avoid misinformed breed selection. In addition, prospective owners should meet the parents of any prospective puppy and appraise their behaviour before making any final acquisition decision.

Veterinary professionals can use the findings of this study to support both prospective and current Poodle-cross designer-crossbreed owners by increasing awareness of undesirable behaviours in these specific designer-crossbreeds. Although this study provides a comprehensive and timely evaluation of the behaviour of the UK's three most common designer-crossbreeds, given the growing popularity of designer crossbreeds more widely and paucity of research on this topic, further studies are warranted to test and expand the results reported.

Supporting information

S1 File. Breed-specific posters. (DOCX) **S2 File. Designer-Crossbreed Questionnaire.** (DOCX) **S3 File. Canine demographic information.** (DOCX) **S4 File. Owner demographic information.** (DOCX) **S5 File. C-BARQ tables.** (DOCX)

Vetnews Editor Note: For all the listed documents, please refer back to me. The links are available from the original article published by ResearchGate.net.

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https://www.kennelclubcharitabletrust.org/

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Owner perceived differences between mixed-breed and purebred dogs

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Abstract

Studies about the behaviours of mixed-breed dogs are rare, although mixed-breeds represent the majority of the world's dog population. We have conducted two surveys to investigate the behavioural, demographic, and dog-keeping differences between purebred and mixed-breed companion dogs. Questionnaire data were collected on a large sample of dogs living in Germany (N = 7,700 purebred dogs representing more than 200 breeds, and N = 7,691 mixed breeds). We found that according to their owners, mixed-breeds were (1) less calm, (2) less sociable toward other dogs, and (3) showed more problematic behaviour than purebreds ($p < 0.001$ for all). Mixed-breeds and purebreds were similar in trainability and boldness scores. However, twelve out of 20 demographic and dog-keeping factors differed between purebred and mixed-breed dogs, and two factors showed considerable (> 10%) differences: neutering was more frequent among mixed-breeds, and they were acquired at older ages than purebreds ($p < 0.001$ for both), which could result in the observed behaviour differences.

After controlling for the distribution of the demographic and dog-keeping factors, we found that mixed breeds were (1) more trainable than purebreds, (2) less calm, and (3) showed more problematic behaviour than purebreds ($p < 0.001$ for all). We discuss that these differences at least partly might be due to selective forces. Our results suggest that instead of being the "average" dogs, mixed-breeds represent a special group with characteristic behavioural traits.

Introduction

When it comes to selecting a new canine companion, choosing an incompatible breed could have dire consequences regarding the well-being of both the owner and the dog. Although the typical behaviour of different dog breeds has attracted considerable scientific attention (e.g. [1]), studies about mixed-breed dogs are rare. Mixed-breed dogs comprise dogs of heterogeneous origin that, by definition, belong to no recognised breed, and their ancestry is usually complex or unknown.

They could be intentionally bred by humans as hybrids of recognised breeds (e.g. 'designer dogs'), they could be offspring of a purebred and a mixed-breed dog, offspring of two mixed-breeds, or descendants of stray, feral or pariah dog populations.

The percentage of mixed-breed dogs (out of all dogs living in households in the USA) is estimated to be around 53% by the American Veterinary Medical Association [2], and 44% by an analysis, decision to publish, or preparation of the manuscript.

The American Pet Products Association [3]. In Germany and in the UK, approximately 31– 33% of dogs are mixed-breeds [4,5], while in Australia, mixed-breeds make up half of the population of dogs living in human households [6]. In scientific databases, mixed-breeds compose approximately one third of the dogs [7–9]. However, these proportions are likely to underestimate the real number of mixed-breeds in the whole dog population, considering that these data estimate only the "owned" dog population (based on pet industry reports, veterinary records, household panels or mail surveys [10]). The mixed-breeds' contribution to the stray, feral and pariah dog populations is hard to estimate reliably. However, they probably represent the majority of dogs worldwide [11].

Mixed-breeds are often assumed to have some phenotypic advantage over purebreds in terms of fitness (e.g. improved health and lower susceptibility to diseases), because they show a lower level of homozygosity and have much higher genetic variation [12–14], which could lead to hybrid vigour [15]. Some studies have reported that adult mixed-breed dogs are less likely to suffer from inherited genetic diseases and live longer than purebreds [12,16–18]. Several studies have detected behavioural differences between mixed-breed and purebred dogs. For example, Bennett and Rholf [7] reported mixed-breeds to be more disobedient, more nervous, more excitable, and exhibited excessive barking more frequently in the case of mixed-breeds than in purebred dogs. Hsu and Sun [19] reported higher ranks for three aggression subscales in mixed breeds (towards strangers, towards dogs, and towards owner/s). Mixed-breeds have also been reported to have an increased risk of developing noise phobia [20]; they were more likely to be aggressive toward unfamiliar people, more fearful, and more sensitive to touch than purebreds [21]. Temesi et al. [22] found higher neuroticism, dog-directed fear and human-directed fear in mixed-breeds than in all AKC breed groups except the Toy dogs group. On the other hand, Ottenheimer-Carrier et al. [23] did not find any differences between purebred and mixed-breed dogs in three personality assessments. One should note, however, that the main aim of these studies was not to compare purebreds and mixed-breeds. Therefore, these results could reflect a number of other systematic differences between these dog groups apart from the dogs' purebred status. For example, dog keeping practices have been reported in association with numerous behaviour traits (e.g. [9,24– 26]); therefore, differences in these factors could result in behaviour differences between mixed-breeds and purebreds.

In the current study, we explored possible differences between mixed-breeds and purebreds in various behaviour traits and dog-keeping characteristics. We hypothesised that when numerous individuals from many breeds are investigated together, breed-specific behavioural

characteristics may balance each other out. Therefore, after controlling for differences in dog-keeping practices between mixed-breeds and purebreds, we expected no differences between the mean behavioural trait scores of a large population of mixed-breed dogs and purebred dogs. The gene flow between the two populations also favours this hypothesis. Purebreds generally originated from ancient mixed-breeds, and mixed-breeds often have purebreds among their ancestors.

Two surveys were developed, both measuring the demographic characteristics of the owners and dogs, as well as the dog-keeping practices. Survey 1 aimed at measuring the dogs' general behaviour tendencies (personality), and Survey 2, typical behaviour problems.

Materials and methods

Ethics statement

We collected the data using an online questionnaire designed to assess the dogs' behaviour via owner report. According to the currently operating Hungarian law ("1998. e´vi XXVIII.To¨rve´ny"—the Animal Protection Act, 3rd paragraph, 9th point), non-invasive observational experiments on dog behaviour are not considered as animal experiments and are therefore allowed to be conducted without any special permission from the University Institutional Animal Care and Use Committee (UIACUC). The filling out of the questionnaires was voluntary and anonymous, so the study did not violate respondents' privacy. Informed consent was included in the introductory letter of the questionnaires.

Subjects

We used the questionnaire method because it allowed us to collect data from a large number of subjects, who were highly diverse in terms of breed and dog-keeping practices. A total of 14,004 dog owners filled out the first survey, and 10,240 filled out the second. We excluded reports with missing data and repetitions (where owners filled in two or more reports about the same dog; we used these data only for calculating test-retest and inter-rater reliability). There were N = 312 owners who filled in both surveys; their demographic and dog-keeping questions were considered only once. We grouped the dogs into purebred and mixed-breed groups based on the owners' specifications. To control for the effect of breed popularity in the purebred group, we defined a cut-off point for both surveys, so that the maximum number of individuals in a given breed was N = 60 for Survey 1 and N = 37 for Survey 2. We determined the cut-off point to match the total number of individuals in the purebred and mixed-breed groups. If a breed was represented with more individuals than the cut-off point, we selected a random sample for the final dataset.

The final sample of Survey 1 consisted of N = 9186 dogs (4593 in the purebred and 4593 in the mixed-breed groups). The purebred group was composed of 254 breeds, and no breeds had more than 60 representatives. The final sample of Survey 2 had N = 6384 dogs (N = 3199 dogs in the purebred and N = 3185 dogs in the mixed-breed group). The purebred group was composed of 251 breeds, and no breeds had more than 37 representatives. Descriptive information of the databases can be found in the supplemental material (S1 and S2 Tables).

Procedure

We conducted two surveys in Germany, both of which were developed by Jesko Wilke, a freelance journalist of the German 'Dogs' magazine. The data were collected online by the magazine's own website (www.dogs-magazin.de). The results of Survey 1 have already been published in [9] and [27].

Both surveys comprised two parts. The first part collected information about the demographic characteristics of the owners and dogs, as well as about dog-keeping practices. Twelve of these questions were the same in both surveys; eight were present in only one. The second part differed between the two surveys. Survey 1 aimed at measuring the dogs' general behaviour tendencies (personality) and was developed based on a human personality inventory. This questionnaire contained 24 items (e.g. "My dog is calm, even in ambiguous situations"), and for each item, the owners were asked to indicate their level of agreement on a 3-point scale (true, partly true, and not true) (see S3 Table). Our previous results using principal component analysis have revealed that 17 items out of the 24 belonged to four components, labelled as calmness, trainability, dog sociability, and boldness, all traits with middle or high internal consistency ([9,27], S3 Table).

Survey 2 listed 12 examples of typical behavioural problems such as "My dog usually does not listen to me when I call him/her back" (S4 Table). Again, the owners indicated for each statement how much they agree with it using a 3-point scale. The questions were designed to assess not only the prevalence of behavioural problems of the dogs, but also the owners' attitude towards these behaviours; i.e. if he/she considers them problematic. The internal consistency of the 12 items of the "Problematic behaviour" scale (Cronbach's alpha = 0.720) indicates that they form one single trait referring to how problematic the owners assess their dogs' behaviour in general. We calculated the trait scores of Survey 1 and Survey 2 by taking the mean of the variables belonging to a given trait.

We used the multiple reports from the same owner about the same dog (N = 208 in Survey 1 and N = 280 in Survey 2) for calculating test-retest reliability, and reports collected from a second owner (of the same dog) (N = 85 in Survey 1 and N = 136 in Survey 2) for assessing inter-rater reliability of the surveys.

Statistical analyses

Reliability analyses of the surveys. We analysed the test-retest and inter-rater reliability of the surveys using Intraclass correlations (test-retest: Two-Way Mixed model, consistency; inter-rater: One-Way Random model, absolute agreement).

Behaviour trait differences between the dog groups. The data were analysed at the individual level with each dog as a separate data point. To analyse the difference between the purebred and mixed-breed dogs, we compared the five behavioural traits (the four personality traits from Survey 1 and the Problematic behaviour trait from Survey 2) between the dog groups using independent-samples t-tests, and the effect size was estimated using Cohen's d.

Demographic and dog-keeping differences between the dog groups. For the twelve questions which were common between the

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two surveys, we pooled the data of the two surveys. The categorical variables were compared between the dog groups (purebred and mixed-breed) using Chi-squared tests with a post hoc test, and the age of the dogs in the two groups was compared using the Mann-Whitney U test. For the comparisons of the demographic and dog keeping factors, we provided unstandardized effect size statistics (i.e. the magnitude of the difference between the groups), since we deemed them more meaningful in this case than standardised measures [28].

Relationship between the behaviour differences and demographic/ dog keeping differences. We analysed the associations between the behavioural traits and demographic and dog-keeping factors using five general linear models (GLM). In each model, the dependent variable was the behavioural trait, and the explanatory factors included the dog group (purebred and mixed-breed) as a fixed factor, and all the demographic and dog-keeping factors in which significant differences were found between the dog groups (age as a covariate, and categorical variables as fixed factors). The aim of these GLM analyses was not only to investigate how the demographic and dog-keeping factors are associated with the behavioural traits, but also to investigate if the behaviour differences between the dog groups remain significant when controlling for any differences in the demographic and dog-keeping factors.

We also added all two-way interactions between the dog group and the demographic / dog keeping factors. A significant interaction would mean that a given factor has a different relationship with the behavioural trait in purebreds than in mixed-breeds. Non-significant interactions were removed from the model sequentially in the order of their decreasing significance; however, all main effects, even non-significant ones, were left in the model. The effect size of each factor in the final model was estimated with partial eta squared, which reflects the proportion of total variation attributable to a given explanatory factor when excluding other factors in the model from the total non-error variation [29].In order to take into account the large number of subjects investigated and the multiple statistical analyses performed, we set the threshold of the significance level to p = 0.00037 (0.05 /134) according to the Bonferroni correction method. Statistical analyses were performed with SPSS version 22.

Results

Reliability analyses of the surveys

Both the inter-observer reliability and the test-retest reliability of the five traits were excellent (Table 1).

Behaviour trait differences between the dog groups

In Survey 1, mixed-breed dogs were rated to be less calm (t-test, N = 9,186, t = 14.910; p < 0.001, Cohen's d = 0.311) and less sociable toward other dogs (t = 4.919; p < 0.001, Cohen's d = 0.103) than purebred dogs. We found no significant difference in trainability (t = 1.946; p = 0.052) or boldness (t = 0.519; p = 0.604) traits between the dog groups. In Survey 2, owners of mixed-breeds reported their dogs' behaviour as more problematic (t-test, N = 6,384, t = 5.577; p < 0.001, Cohen's d = 0.140) than the owners of purebreds.

Demographic and dog-keeping differences between the dog groups

We found significant differences between purebred and mixed-breed dogs in 12 out of the 20 investigated demographic and dog-keeping factors (Table 2), after correcting for multiple comparisons. Ten of these factors were common between the two surveys, and two factors were investigated in Survey 2 only. However, due to the large sample size, even with the p < 0.00037 threshold, a significant result in most of the factors indicated only a small (3–6%) difference in a given category between the dog groups. Regarding the demographic factors, mixed-breed dogs were found to be older in our sample, and there were more females among them than among purebreds. Mixed-breed owners were more likely to be women, they were younger, had a lower level of education and had less previous experience with dogs than the owners of purebreds. However, we found no difference between the groups in the number of adults and children in the household.Regarding the dog keeping factors: mixed-breeds were more likely to be neutered, owners acquired them at an older age, they received less training, and they were more likely to be kept only indoors and as single dogs than purebred dogs. However, mixed-breed owners walked their dogs for longer than the owners of purebreds. We found no difference between the groups in how much time the owners spend with their dog in general, or with playing, for what purpose the owners keep the dog, whether they buy gifts for the dog and whether the dog is allowed onto the bed. (Table 2).

Relationship between the behavioural traits and the demographic/dog keeping factors

When controlling for all demographic and dog-keeping factors, where the difference between the dog groups was significant in our previous analysis (10 factors for the traits from Survey 1 and 12 factors for the Problematic behaviour trait from Survey 2 see Table 2), we found that the dogs' breeding status was still significantly associated with the calmness and problematic behaviour traits (Table 3), and interestingly, it was also significant for trainability.

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Table 1. Reliability measures of the five behaviour traits.

	Calmness	Trainability	Dog sociability	Boldness	Problematic behaviour
Inter-observer reliability (ICC 1,k)					
ICC	0.830	0.753	0.849	0.874	0.766
F	F84,85 = 5.881	F84,85 = 4.046	F84,85 = 6.640	F84,85 = 7.939	$F_{135,136}$ = 4.265
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Test-retest reliability (ICC 3,k)					
ICC	0.899	0.886	0.944	0.912	0.911
F	$F_{207,207}$ = 9.923	$F_{207,207}$ = 8.791	$F_{207,207}$ = 17.788	$F_{207,207}$ = 11.399	$F_{279,279}$ = 11.206
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Table 2. Comparison of demographic and dog-keeping factors between purebred and mixed-breed dogs.

Factors in both surveys	Categories	Purebred N = 7,698	Mixed-breed N = 7,691	Statistics	Absolute magnitude of the difference
Dogs' age in years (mean ±SD)	–	3.42 (±3.13)	3.68 (±3.24)	z = 5.83 p < 0.001	0.26 years
Dogs' sex	Male	57.2%	52.7%	χ^2 = 31.25	male: 4.5%
	Female	42.8%	47.3%	p < 0.001	female 4.5%
Dogs' neuter status	Intact	69.7%	51.3%	χ2 = 544.84	intact: 18.4%
	Neutered	30.3%	48.7%	p < 0.001	neutered: 18.4%
Dogs' age at acquisition	bred by owner	2.0%	1.6%	χ2 = 547.97	bred by owner: 0.4%
	2–12 weeks	62.5%	44.6%	p < 0.001	2–12 weeks: 17.9%
	3–12 months	20.7%	28.3%		3–12 months: 7.6%
	> 1 year	14.8%	25.5%		> 1 year: 10.7%
Dogs' training experience	no training	32.7%	41.6%	χ2 = 168.24	No training: 8.9%
	1 type	25.7%	25.8%	p < 0.001	1 type: 0.1%
	2 types	22.3%	18.2%		2 types: 4.1%
	3 or more types	19.3%	14.4%		3 or more: 4.9%
Owners' gender	Man	20.0%	16.4%	χ^2 = 32.08	man: 3.6%
	Woman	80.0%	83.6%	p < 0.001	woman: 3.6%
Owners' age	18 years	5.0%	4.8%	χ^2 = 69.54	18 years: 0.2%
	19–30 years	25.9%	31.2%	p < 0.001	19–30 years: 5.3%
	31–60 years	65.6%	61.8%		31–60 years: 3.8%
	> 60 years	3.5%	2.2%		> 60 years: 1.3%
Owners' education	primary school	20.6%	22.0%	χ^2 = 20.63	primary: 1.4%
	secondary school	40.5%	40.8%	p < 0.001	secondary: 0.3%
	College	25.7%	26.4%		college: 0.7%
	University	13.1%	10.8%		university: 2.3%
N of previous dogs	no previous dog	39.7%	46.2%	χ2 = 178.30	no previous dog: 6.5%
	1 dog	25.5%	28.0%	p < 0.001	1 dog: 2.5%
	2 dogs	16.0%	14.0%		2 dogs: 2.0%
	3 or more dogs	18.8%	11.8%		3 or more dogs 7.0%
Purpose of keeping the dog	family member only	45.4%	47.1%	χ^2 = 6.51	fam. mem. only: 1.7%
	family member + other	47.3%	46.3%	p = 0.039	fam. mem.+other: 1.0%
	not family member	7.3%	6.6%		not fam. mem.: 0.7%
N of people in the household	only 1 person	10.6%	11.8%	χ^2 = 9.46	only 1 person: 1.2%
	2 people	45.1%	43.0%	p = 0.009	2 people: 2.1%
	3 or more people	44.3%	45.2%		3 or more: 0.9%
N of dogs in the household	no other dog	66.3%	72.6%	χ^2 = 99.30	no other dog: 6.3%
	1 other dog	20.7%	18.8%	p < 0.001	1 other dog: 1.9%
	2 other dogs	13.0%	8.6%		2 other dogs: 4.4%
Factors only in Survey 1	**Categories**	**Purebred N = 4,593**	**Mixed-breed N = 4,593**	**Statistics**	**Absolute magnitude of the difference**
Hours spent with the dog/ day	3 hours	27.0%	28.7%	χ^2 = 3.41	3 hours: 1.7%
	> 3 hours	73.0%	71.3%	p = 0.065	> 3 hours: 1.7%

Frequency of playing/ week	**1–5 days**	**20.0%**	**21.8%**	**$\chi^2 = 4.56$**	**1–5 days: 1.8%**
	6–7 days	**80.0%**	**78.2%**	**p = 0.033**	**6–7 days: 1.8%**
Factors only in Survey 2	**Categories**	**Purebred N = 3,199**	**Mixed-breed N = 3,185**	**Statistics**	**Absolute magnitude of the difference**
N of children in the household	**1 or more**	**20.7%**	**21.4%**	**$\chi^2 = 0.54$**	**1 or more: 0.7%**
	None	**79.3%**	**78.6%**	**p = 0.462**	**none: 0.7%**
Where the dog is kept	**only indoors**	**71.3%**	**76.7%**	**$\chi^2 = 24.25$**	**only indoors: 5.4%**
	in- and outdoors	**26.4%**	**21.3%**	**p < 0.001**	**in- and outdoors: 5.1%**
	only outdoors	**2.3%**	**2.0%**		**only outdoors: 0.3%**
Hours spent walking the dog	**< 1 hour**	**12.1%**	**8.8%**	**$\chi^2 = 25.17$**	**< 1 hour: 3.3%**
	1–3 hours	**78.0%**	**78.8%**	**p < 0.001**	**1–3 hours: 0.8%**
	> 3 hours	**9.9%**	**12.4%**		**> 3 hours: 2.5%**
Hours spent playing / day	**1 hour**	**68.6%**	**68.7%**	**$\chi^2 = 0.001$**	**1 hour: 0.1%**
	> 1 hour	**31.4%**	**31.3%**	**p = 0.987**	**> 1 hour: 0.1%**
Buy gifts for the dog	**Yes**	**68.5%**	**65.8%**	**$\chi^2 = 5.21$**	**yes: 2.7%**
	No	**31.5%**	**34.2%**	**p = 0.023**	**no: 2.7%**
Allow the dog into the bed	**Yes**	**39.3%**	**37.6%**	**$\chi^2 = 1.98$**	**yes: 1.7%**
	No	**60.7%**	**62.4%**	**p = 0.160**	**no: 1.7%**

However, the dog group did not remain as a significant main effect in the GLM models of dog sociability and boldness after the Bonferroni correction ($p = 0.009$ and $p = 0.003$, respectively).

For each categorical variable, the proportion of the dogs falling into each category is presented separately for each dog group. Where significant group differences were found (as indicated by the Chi-squared tests with z post-hoc tests), the category with the larger proportion in a given dog group was marked in bold. Only differences with $p < 0.00037$ were considered significant (marked in italics). The absolute magnitude of the difference is presented as a measure of effect size.

Aside from the dog group, we found numerous associations between the demographic and dog keeping factors and the behaviour traits (for statistical details see Table 3), but there were no significant interactions between the dog group and any of the factors in any of the models.

Calmness: the 11 factors together accounted for 4.9% of the total variance in this trait. Five factors had significant associations after the Bonferroni correction: mixed-breeds were less calm than purebreds, older dogs were calmer, and neutered dogs were less calm. Dogs acquired before 12 weeks of age were calmer than dogs acquired at an older age. Owners under the age of 18 years assessed their dogs as calmer than older owners' assessments. From these factors, only the dog group had a higher than 1% effect size (1.2%) (Table 3).

Trainability: the 11 factors together accounted for 10.3% of the total variance in this trait. Four factors had significant associations after the Bonferroni correction: mixed-breeds were more trainable than purebreds, older dogs were less trainable than younger ones, dogs acquired at > 1 year old were less trainable than dogs acquired at a younger age, and a higher training level was associated with a higher trainability assessment. From these four factors, three had a higher than 1% effect size: age (2.2%), age at acquisition (1.3%) and training level (3.7%) (Table 3).

Dog sociability: the 11 factors together accounted for 8.3% of the total variance in this trait. Four factors had significant associations after the Bonferroni correction: older dogs were less sociable towards other dogs than younger dogs; we found higher sociability in females than in males, and in dogs acquired between 2–12 weeks of age than in dogs acquired at older ages.

Non-significant main effects were not removed from the models. Significant effects at the level of $p < 0.00037$ are marked in italics. Factors marked with asterisks were investigated in Survey 2 only.

Owners younger than 30 years of age reported lower sociability in their dogs than older owners did. From these four factors, only age had a higher than 1% effect size (5.4%) (Table 3).

Boldness: the 11 factors together accounted for 4.1% of the total variance in this trait. Three factors had significant associations after the Bonferroni correction: males were reported to be bolder than females, dogs acquired between 2–12 weeks of age were bolder than dogs acquired at older ages, and dogs receiving only one training type were bolder than dogs receiving no training or three or more types. From these three factors, two had a higher than 1% effect size: sex (1.4%) and age at acquisition (1.6%) (Table 3).

Problematic behaviour: the 13 factors together accounted for 15.4% of the total variance in this trait. Seven factors had significant associations after the Bonferroni correction: owners of purebreds, older dogs and females reported fewer behaviour problems in their dogs. Dogs with more training experience displayed fewer behavioural problems (according to the owner). More educated and more experienced owners also reported that their dogs had fewer behaviour problems. Finally, owners who had longer walks with their dogs reported fewer behaviour problems. From these seven factors, four had a higher than 1% effect size: age. (2.5%), training (6.3%), N of previous dogs (1.4%) and hours spent walking (2.1%) (Table 3).

Table 3. Relationship between the demographic and dog-keeping factors and the behaviour traits investigated with GLMs.

		Calmness			Trainability			Dog sociability			Boldness			Problematic behaviour		
Source	**df**	**F**	**p**	**partial eta²**	**F**	**p**	**partial eta²**	**F**	**p**	**partial eta²**	**F**	**p**	**partial eta²**	**F**	**p**	**partial eta²**
Corrected Model		21.4	0.000	0.049	47.6	0.000	0.103	37.7	0.000	0.083	17.7	0.000	0.041	44.6	0.000	0.154
Dog group	1	111.0	0.000	0.012	12.9	0.000	0.001	6.9	0.009	0.001	9.1	0.003	0.001	23.8	0.000	0.004
Dogs' age	1	35.9	0.000	0.004	207.1	0.000	0.022	524.5	0.000	0.054	5.0	0.025	0.001	160.4	0.000	0.025
Dogs' sex	1	1.4	0.242	0.000	0.6	0.438	0.000	26.7	0.000	0.003	128.1	0.000	0.014	28.4	0.000	0.004
Dogs' neutered status	1	54.9	0.000	0.006	6.8	0.009	0.001	1.2	0.278	0.000	5.7	0.017	0.001	0.2	0.630	0.000
Age at acquisition	3	25.9	0.000	0.008	39.2	0.000	0.013	6.4	0.000	0.002	48.5	0.000	0.016	2.9	0.034	0.001
Training experience	3	1.0	0.413	0.000	117.3	0.000	0.037	5.7	0.001	0.002	6.2	0.000	0.002	141.9	0.000	0.063
Owners' gender	1	7.7	0.005	0.001	4.5	0.033	0.000	5.4	0.020	0.001	3.7	0.055	0.000	1.7	0.189	0.000
Owners' age	3	8.4	0.000	0.003	0.4	0.747	0.000	6.6	0.000	0.002	1.9	0.122	0.001	5.7	0.001	0.003
Owners' education	3	2.0	0.115	0.001	5.5	0.001	0.002	5.8	0.001	0.002	1.2	0.316	0.000	19.0	0.000	0.009
N of previous dogs	3	5.0	0.002	0.002	5.3	0.001	0.002	1.8	0.152	0.001	1.7	0.155	0.001	30.2	0.000	0.014
N of dogs in household	2	2.1	0.129	0.000	0.9	0.388	0.000	1.5	0.222	0.000	1.2	0.297	0.000	3.4	0.033	0.001
Where the dog is kept*	2							N/A						2.6	0.071	0.001
Hours spent walking*	2							N/A						69.0	0.000	0.021
Error		9144			9144			9144			9144			6351		

Discussion

In this study, we demonstrated that purebred and mixed-breed dogs differ in some of their personality traits and in the frequency of behaviour problems reported by the owner. Purebred and mixed-breed dogs are also kept differently within owners' homes. In general, compared to how the owners of purebreds rated their dogs, mixed-breed dogs were perceived by their owners as less calm, and less sociable with other dogs, and their owners found their behaviour to be more problematic. However, the analyses of the effect sizes indicated small differences in all traits, with the possible exception of the calmness trait. Previous studies have reported similar behavioural differences between purebred and mixed-breed dogs, mainly in fearfulness, neuroticism and aggression-related behaviours [7,19,21,22].

We also found numerous differences between the purebred and mixed-breed dogs in their demographic and dog keeping characteristics: 12 from the 20 comparisons were significant after correcting for multiple comparisons. Mostly, demographic factors differed, e.g. more women keep mixed-breeds than men do, owners of mixed-breeds are less educated, are younger and have less experience with dogs.

Probably related to the demographic differences, we also found differences in the dog keeping characteristics, e.g. mixed-breeds received less training, they were more likely to be kept only indoors, and as single dogs. However, we found no difference in the attitude and commitment of the owners (e.g. purpose of keeping, time spent with the dog, playing, giving gifts or allowing the dog on the bed), with the exception that mixed-breeds' owners walked their dogs for longer than the owners of purebreds.

However, for the majority of the factors, the magnitude of the differences was too small to be relevant, regardless of statistical significance. Only two factors showed considerable (> 10%) differences between purebreds and mixed-breeds: the dogs' neuter status and their age at acquisition. Mixed-breed dogs were more likely to be neutered, less likely to be acquired between 2–12 weeks of age, and more likely to be adopted at an older age than purebred dogs.

When we investigated the relationship between the demographic and environmental factors and the behaviour traits, we found that 9 out of the 12 factors were significantly associated with at least one behaviour trait. Most of these associations were in agreement with the results from our

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previous study by Kubinyi et al. [9]. We found no significant interactions between the dog group and any demographic or dog keeping factors in any of the behaviour traits, indicating that these factors have similar associations with the behaviour both in purebreds and in mixed-breeds.

However, it is worth considering that these three results, i.e. the dog group differences in behaviour, the dog group differences in demographic/dog keeping factors, and the associations between the behavioural traits and the demographic/dog keeping factors are not independent from each other. It is possible that we found behaviour differences between the dog groups only because mixed-breeds and purebreds show a different distribution regarding numerous demographic/dog keeping factors, which are in turn linked to the measured behaviour traits. To rule out this possibility, we used statistical models which controlled for all demographic and dog keeping factors where dog group differences were found.

Contrary to our earlier result, where mixed-breeds were found to have lower sociability towards other dogs, the General Linear Model indicated no significant effect of the dog group on the dog sociability trait. In this model, the strongest predictors of dog sociability were the dog's age, sex, age at acquisition, and owners' age: older dogs, dogs acquired at an older age, males and dogs of younger owners had lower dog sociability ratings.

Since in our sample, mixed-breeds were older, were acquired at an older age and had younger owners than purebreds, the lower sociability of the mixed-breeds we found in the initial behaviour comparison, seems to be an indirect result of these demographic differences. After controlling for them, we found no difference in dog sociability between the dog groups. The opposite seems to be the case with the trainability trait. We found that mixed-breeds are more trainable than purebreds, but only after controlling for the demographic and dog keeping differences. Trainability was most strongly associated with dog's age, age at acquisition, and training level: older dogs, dogs acquired at older ages, and dogs with a lower training level had lower trainability ratings. In this case, the characteristics of our sample (i.e. mixed-breeds were older, were acquired at an older age and received less training than purebreds), seems to mask the behavioural difference, therefore we only found higher trainability in mixed-breeds when we controlled for these demographic and dog keeping differences.

In the cases of the boldness, calmness and problematic behaviour traits, the GLM analyses corroborate the initial behaviour comparisons. For boldness, neither the initial behaviour comparison nor the GLM analysis indicated a significant difference between the dog groups. For the calmness and problematic behaviour traits, the dog group remained as a significant predictor in the models even after controlling for the measured demographic and dog keeping factors.

This suggests that these behaviour differences (i.e. less calm and more problematic behaviour in mixed-breed dogs), cannot be attributed solely to the environmental differences–at least not to those investigated in the current study.

Alternative explanations for the observed dog group differences, involve possible genetic differences. For example, Schneider et al. [21] suggested that dog breeders generally focus on producing individuals with desirable behaviour, resulting in more favourable behaviour characteristics, and a lower frequency of behaviour problems in purebreds compared to mixed-breeds. Ga´csi et al. [30] also raised an interesting hypothesis involving genetic influences, which posits that the present day mixed-breeds may originate from a population that has been under continuous selection for independent survival skills. It is also possible that developing dogs with independent survival skills may not be favourable for breeders, thus the two hypotheses are linked to each other. Although we could not directly test any of these hypotheses in the current study, our results lend support to both of them.

Breeders may selectively breed dogs that make good human companions, which includes being calmer and showing fewer behaviour problems. In contrast, for independent survival, more assertive and more nervous/alert behaviour could be advantageous, for example to solve problems independently, avoid strangers, other dogs, or possibly dangerous objects (cars, trains). We have to note however, that both outcomes define mixed-breeds as having at least one mixed-breed parent, and do not include dogs that are a mix of purebreds. We do not know the proportions of such individuals in our sample, so we were not able to make this definition.

Developmental effects, like early socialization, rearing environment and past experiences can also provide an explanation for the observed behaviour differences. Previous studies have shown that the amount of appropriate socialization during early development plays a large role in whether or not the dog develops behavioural problems, including fearfulness and aggression (reviewed in [31]). For example, dogs raised in a home with children were scored higher in energy level, excitability, and distractibility; and dogs that had been able to play with other dogs scored during development scored lower on separation-related behavior [32]. Mixed-breeds are highly overrepresented in shelters (e.g. 80%, [33]) and among stray dogs relinquished to shelters (75.2%, [34]), partly because puppies from unintended litters relatively frequently end up in a shelter or on the street. However, unintended litters rarely occur between dogs from the same breed. Thus mixed-breeds, which were adopted at an older age likely originated from shelters or from the street, where they lived in a completely different environment than dogs raised by their owners [35,36]. The results of numerous studies provide strong evidence of a link between exposure to stressors associated with shelter life (like social and spatial restrictions), and the prevalence of undesirable behaviours in later life [23,37–39].

Our study is the first that was primarily aimed at addressing the possible behavioural and environmental differences between purebred and mixed-breed dogs, and as such, it is largely exploratory in nature. The most important limitation of the study is related to its subjectivity, as it was based on owner reports. Although the questionnaire method in general has proven to be a reliable and valid measurement, especially when complex behaviour traits are assessed (e.g. [40]), and our surveys showed good reliability, our study was still an indirect evaluation based on the owners' memories of their dogs' behaviour.

Therefore, differences in the owners' attitude towards purebreds and mixed-breeds may bias our results. Although it was not possible for us to determine whether the dogs were really purebred, or just that the owners believed them to be, some owners may value a dog's pedigree as a status symbol, or believe that a pedigree means that the dog possesses superior behavioural characteristics.

Such owners may have a tendency to "overrate" their dogs, or report less problematic behaviours. However, we believe that these biases may be minimized by large sample sizes. Moreover, our owners represented a self-nominated, convenience sample, who are interested in their dogs' behaviour, and all our subjects were living in families, so we have no information available about the shelter, stray or feral dog populations. Finally, no study could possibly measure all the relevant environmental and dog keeping factors in association with the dogs' behaviour; for example, it would have been interesting to determine where the dogs in the present study were obtained, and how this may have affected their behavioural traits.

Conclusions

We found numerous behavioural, demographic, and environmental differences between purebred and mixed-breed dogs based on the owners' reports. However, many of these were small and their biological relevance is questionable. The dog sociability and trainability traits were more strongly influenced by the environmental characteristics of our sample: the mixedbreeds' lower sociability towards other dogs we initially found, seemed to be an indirect result of the environmental differences between purebreds and mixed-breeds, while the mixedbreeds' higher trainability seemed to be masked by these environmental differences. However the differences we found in calmness and problematic behaviour traits were less influenced by environmental factors, and were more likely due to early socialization and / or genetic effects. Therefore, our results suggest that care should be taken when using mixed-breeds as control dogs in breed or species comparison studies. Despite their diversity in morphological terms, mixed-breed dogs may not represent the 'average' dogs, but instead constitute a special group of dogs with characteristic behaviour traits.

Supporting information:
S1 Table. The list of breeds included in the study. (PDF)
S2 Table. Descriptive data of the purebred group in Survey 1 (S1) and Survey 2 (S2). (PDF)
S3 Table. Questionnaire items in Survey 1 (see [9]). (PDF)
S4 Table. Questionnaire items in Survey 2. (PDF)
S5 Table. Detailed information about the subjects and data. (XLSX)

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Author Contributions

Conceptualisation: BT A´M EK.

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Investigation: BT A´M EK.

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Writing – review & editing: BT A´M EK.

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References available on request



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A pilot study to assess the feasibility of a computer-assisted surgery system for navigation in the equine cervical spine

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Objective
To validate the accuracy of the Synaptive Medical computer-assisted surgery (CAS) system for navigation in the equine cervical spine, focusing on anatomical targets that require precise localisation.

Methods
3 equine cervical spine cadavers were used (C1-T1) for an experimental study design. A custom fiducial array was mounted into the dorsal spinous process of C2, with additional fiducial markers distributed for landmark registration. Four participants with varying surgical expertise used the Synaptive Medical CAS system to navigate 9 radiodense pins into 3 anatomical targets, including the intervertebral foramen, articular process joint, and intervertebral disc. Pre- and postprocedural CT scans were used to evaluate pin placement accuracy, defined as the Euclidean distance between planned and achieved points. The procedure duration was also recorded.

Results
The mean navigation error between the planned and reached target points was 11.33 ± 11.02 mm. Surgical experience influenced procedure duration; however, it did not significantly affect accuracy. Additionally, our results suggested that placement of a fiducial array into the dorsal spinous process of C2 allowed for successful registration.

Conclusions
Use of the Synaptive Medical CAS system for navigation-assisted procedures in the equine cervical spine is feasible and may enhance surgical precision in veterinary applications.

Clinical Relevance
This study provides insight into the potential integration of CAS into the clinical application of equine cervical spine procedures. This validation supports that CAS can be an option for minimally invasive approaches aimed at reducing clinical complications when accessing the equine cervical spine.

Computer-assisted surgery (CAS) systems provide real-time visualisation of surgical instruments relative to patient anatomy, facilitating preoperative planning, intraoperative guidance, and postoperative assessment. Its success in human medicine has demonstrated various benefits, including minimally invasive approaches, improved accuracy, enhanced surgical planning, and instrument navigation, ultimately contributing to better clinical outcomes.1–4 In the specific use of CAS for spine surgery, this technology is especially useful for less experienced surgeons in lumbar pedicle screw placement to reduce spinal canal perforation rate and intraoperative time.[5,6] The exceptional outcomes associated with CAS have contributed to its growing adoption worldwide.

The benefits of CAS have been well documented in human medicine as described above. However, despite its numerous advantages in this field, studies[7,8] on the use of CAS in veterinary medicine remain limited. In horses, CAS has been reported to improve accuracy in orthopaedic surgery and neurosurgery. A literary review[8] of CAS in equine surgery noted that CAS assisted in the success of equine surgical cases such as a transarticular drilling procedure to promote ankylosis in the distal tarsal joint, removing a fractured articular fragment of the middle phalanx, and curetting an osteolytic lesion on the calcaneal tuberosity. Although these studies show promising results, CAS has yet to become a mainstay in veterinary medicine, in addition to proving its potential in the spinal vertebrae.

As this advanced technology becomes more readily accessible to veterinarians, we can expect to see a rapid period of growth and validation.

Several CAS navigation systems have been developed for a specific anatomical region, including cranial, spinal, or orthopaedic applications. However, none have been specifically designed or validated for veterinary use. The Synaptive Medical CAS system (Synaptive Medical Inc) was developed for cranial procedures in human medicine9–11 and is optimised for MRI compatibility, as most of its indicated procedures involve neurosurgical access to the brain. Its performance in equine cranial procedures remains unproven, and it has not been tested for noncranial procedures. Evaluating the system's potential in veterinary surgery could broaden its use for complex neuroanatomical and orthopaedic interventions. Therefore, the objectives of this study were to (1) assess the accuracy and feasibility of the Synaptive Medical CAS system for navigating the equine cervical spine, (2) determine the influence of surgical experience on performance, and (3) identify optimal fiducial marker placement for registration.

Methods

Three equine cervical spine specimens (C1-T1) were obtained from adult Quarter Horses with no history or clinical evidence of cervical spine disease, which was confirmed by pre-CT images, following

approval from Colorado State University. En bloc cervical specimens were collected postmortem from animals humanely euthanised via IV injection of barbiturate for reasons unrelated to this study. The previous horses' owners had signed consent forms for postmortem donation of equine cadavers for research and teaching purposes. Osseous and soft tissue structures relevant to surgical navigation, including musculature, ligaments, and joint capsules, were preserved in all cervical specimens.

The cadavers were positioned in right lateral recumbency for all procedures. A 3-D–printed custom fiducial array made of polylactic acid filament (Hatchbox; 3.0 mm) was mounted on a 15-cm titanium rod and secured to the dorsal spinous process of C2 **(Figure 1)**. The array contained 6 fiducial markers and was positioned approximately 6 cm above the dorsal surface of the specimen to ensure unobstructed visibility by the navigation camera. Additionally, 4 adhesive fiducial markers (MultiModality Fiducial Markers; Izi Medical) were affixed to the skin along the head and cervical region to facilitate surface registration.

Pre- and postprocedural CT imaging was performed to acquire datasets for navigation system registration and accuracy assessment. Scans were obtained using cone beam CT equipment (Siemens Somatom Definition, Siemens Healthineers; or O-arm O2 Imaging System, Medtronic) with acquisition parameters of 120 kV and 35 to 50 mAs. Imaging protocols were optimised to capture high-resolution details of the cervical region (C1-T1), which served as the region of interest for all specimens (Figure 1).

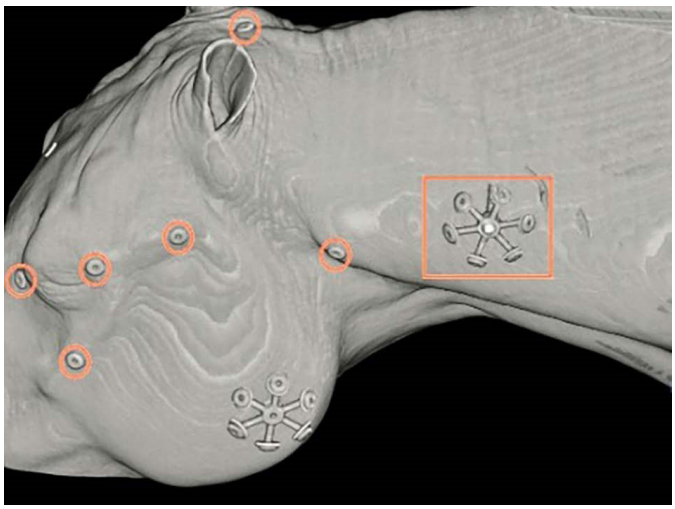


Figure 1—Image of cadaver 1 was acquired with a CT and uploaded into the Synaptive Medical computer-assisted surgery system for registration. Red circles indicate the 6 fiducial doughnuts placed on the skin. The red rectangle indicates the array drilled into the spinous process of C2 with 6 fiducials. Other fiducials were placed on the body, but were not selected due to the maximum limit

The preprocedural CT datasets were imported into the Synaptive Medical CAS system to generate 3-D reconstructions for navigation planning and registration. Successful registration required a minimum of 5 fiducial markers, with at least 1 marker located in each anatomical plane (x, y, and z). Following registration, the total system error was recorded as 3.37, 3.16, and 2.74 mm for cadavers 1, 2, and 3, respectively. Postprocedural scans were used to evaluate the accuracy of instrument placement. Anatomical targets were selected based on clinical relevance, including the intervertebral foramen at C2-C3, the articular process joint at C3-C4, and the intervertebral disc at C3-C4. Preoperative planning was performed for all targets, which were accessed individually on the left side while cadavers remained in right lateral recumbency. Trajectories were chosen to minimise distance and avoid obstruction by surrounding anatomy **(Figure 2)**.

To evaluate the effect of surgical experience on CAS use, 4 participants with varying expertise were enrolled: a board-certified equine surgeon with 14 years of experience (Expert), another board-certified equine surgeon with 5 years of experience (Proficient), a research veterinarian (Competent), and a second-year veterinary student (Novice).

Each participant used radiodense pins of different lengths (5, 10, 15, and 20 mm, respectively) fabricated from 22-gauge needles. Navigation was performed using a 16-gauge X 13-cm spinal needle attached to the Synaptive Medical navigation pointer, with the participant's assigned pin preloaded at the distal tip for placement at each target site. Procedure duration was recorded for each participant to assess the relationship, if at all, with surgical experience. Following completion of all 12 target placements per cadaver, postprocedural CT scans were obtained using the same imaging protocol as the preprocedural scans.

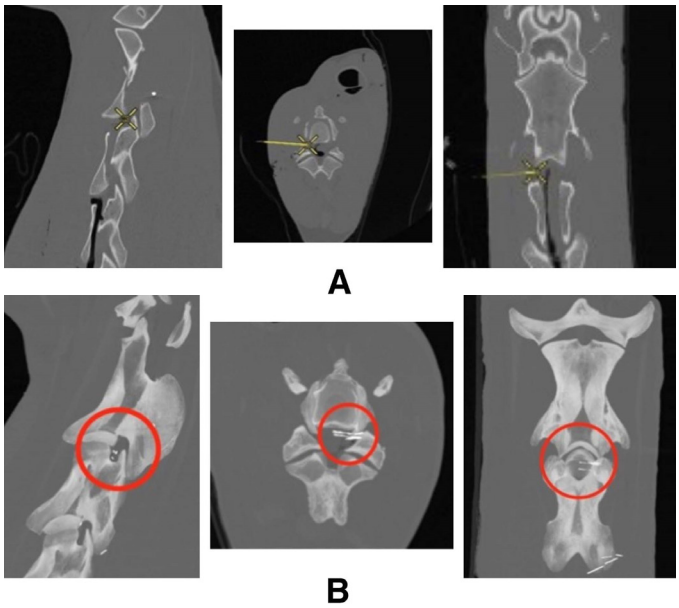


Figure 2—A—Images from prenavigation and postnavigation. This set of images shows the x, y, and z planes of what is seen in the Synaptive Medical computer-assisted surgery system when setting the target point and trajectory. The yellow "X" denotes the target being the intervertebral foramen C2-C3. B—This set of images shows postoperative CT images after placing the pins based on pre-navigation planning from A. All pins for this navigation were in the desired anatomical area

These postoperative images were analysed in Horos software (version 3.6.6), which generated 3-D reconstructions to locate each pin and quantify navigation accuracy.

Accuracy was determined by calculating the Euclidean distance between the planned target (point 1) and the distal end of the pin (point 2) using the following formula:

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Point 1 was estimated as the location within the intended target that minimised the distance to point 2. Pins successfully placed within the target were assigned a Euclidean distance of 0.00 mm.

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Statistical analysis

Data distribution was determined with the Shapiro-Wilk test for normality of data parameters. Continuous data are reported as means ± SD. Comparisons of navigation accuracy, ie, distance from the intended target and procedure duration among participants with different levels of surgical experience, were performed using repeated measures one-way ANOVA. This test was chosen to compare the means across the varying groups with significance set at $P < .05$ (GraphPad Prism, version 10.6.0).

Results

The Synaptive Medical CAS system demonstrated compatibility with CT images of the equine cervical spine, enabling effective image registration and real-time navigation (Figure 1). The system successfully processed CT scans to generate accurate 3-D reconstructions, allowing precise registration of fiducial markers on the equine spine. This compatibility facilitated seamless integration of the equine anatomical data into the navigation system, supporting reliable targeting and guidance throughout the procedure. Moreover, fiducial markers placed on the skin and a drilled fiducial array allowed for successful registration in the x, y, and z planes.

Participant	Average duration of navigations (s)	Average Euclidean distance from targets (mm)
Expert	73.44	13.13
Proficient	44.89	15.09
Competent	65.78	8.73
Novice	127.11	11.20

Table 1—Mean duration of navigations and Euclidean distance from targets by each participant with varying degrees of surgical experience

Participant/ cadaver	IVF C2-C3 (mm)	FJ C3-C4 (mm)	IVD C3-C4 (mm)
Expert			
1	0.00	11.30	0.00
2	12.24	17.37	12.97
3	6.12	14.33	6.48
Proficient			
1	0.00	0.00	32.46
2	40.34	12.12	14.26
3	11.73	17.81	7.10
Competent			
1	0.00	11.71	27.63
2	*	17.86	12.62
3	0.00	0.00	0.00
Novice			
1	0.00	9.17	0.00
2	35.66	28.68	13.64
3	7.15	6.55	0.00

Table 2—Calculated Euclidean distance from targets by each participant with varying degrees of surgical experience

**Measurement could not be obtained due to user error in the pin not being placed appropriately. FJ = Facet joint. IVD = Intervertebral disc. IVF = Intervertebral foramen.*

The mean ± SD Euclidean distance for each target with all 3 rounds included was as follows: the intervertebral foramen between C2 and C3 was 10.26 ± 14.53 mm, the articular process joint between C3 and C4 was 12.48 ± 8.12 mm, and the intervertebral disc between C3 and C4 was 11.16 ± 10.72 mm. Interestingly, all pins navigating for the intervertebral foramen between C2 and C3 in cadaver 1 were within the desired area (Figure 2). The overall mean ± SD duration of navigation with the CAS system was 77.81 ± 50.16 seconds per participant. The mean ± SD duration for the Expert participant was 73.44 ± 13.60 seconds, 44.89 ± 27.68 seconds for the Proficient participant, 65.78 ± 8.19 seconds for the Competent participant, and 127.11 ± 13.50 seconds for the Novice participant. **Table 1** summarises the mean duration and Euclidean distance for each participant across all 3 cadavers for each target. **Table 2** provides detailed results for each individual navigation. Procedure duration differed significantly between the Novice and the remaining participants **(Figure 3)**. However, no statistically significant differences were observed between participants in navigation accuracy.

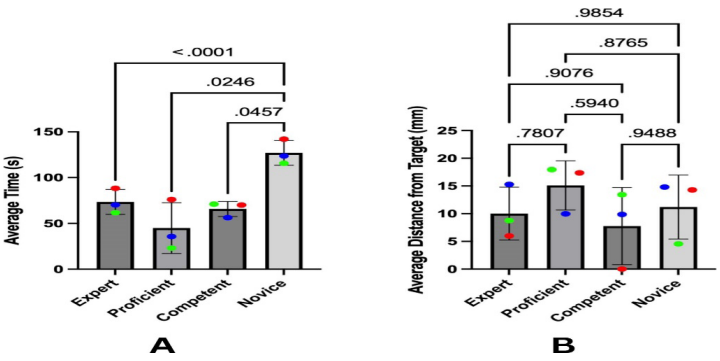


Figure 3—Comparison of duration (A) and accuracy (B) between individuals of different degrees of surgical experience.An ANOVA test was performed for each parameter. There is statistical significance for time but not accuracy between participants with P < .05. Red is the intervertebral foramen C2-C3, blue is the facet joint C3-C4, and green is the intervertebral disc C3-C4

Discussion

Computed tomography scans of all cadaveric specimens were successfully acquired and seamlessly integrated into the Synaptive Medical CAS system for registration and navigation. Although the Synaptive Medical CAS system was originally developed for MRI-based neurosurgical applications in human medicine, MRI remains costly and less accessible in veterinary practice. The present study demonstrates that CT imaging, being more widely available, cost-effective, and practical in veterinary settings, can be successfully utilised with the Synaptive Medical CAS platform for equine cervical spine navigation.

Previous studies[12] in human medicine have shown how CT scans for CAS systems provide the benefits of not only increased accuracy but also shorter operation time, fewer postoperative complications, and improved safety. Furthermore, while Synaptive Medical Inc originally indicated the system for cranial applications, our study demonstrates its efficacy in noncranial regions, including the equine cervical spine. These findings suggest that CT-guided navigation could provide a practical and reliable alternative to MRI for translational applications in veterinary spinal surgery.

In this study, the mean ± SD Euclidean distance across all targets was 11.33 ± 11.02 mm, indicating that while the current level of accuracy may not yet meet the requirements for direct clinical application, it supports the feasibility of using CAS for equine cervical spine procedures, specifically cranial cervical spine segments, and establishes a solid foundation for further optimisation. Reported accuracy values for CAS in veterinary orthopaedic applications vary widely. For example, a retrospective equine study[8] found mean deviations of 1 to 2 mm. Similarly, a cadaveric study[13] placing cortex screws in the proximal phalanx reported a 0.7-mm deviation.

Another study[14] in cats using CAS for sacroiliac luxation repair reported a 4.2-mm deviation in the first 5 cases, improving to 0.9 mm in subsequent cases. Compared to these studies, the higher mean deviation observed here likely reflects several factors, including the adaptation of a brain-focused software for cervical orthopaedic procedures, manual registration, makeshift instrumentation used for navigation, such as the long spinal needle with poor rigidity, and anatomic complexity in accessing these targets.

Historically, spinal imaging and navigation evolved from cranial imaging, where fiducial markers are relatively stable due to the inherent rigidity of the skull.[15] In contrast, when adapting CAS systems to the spine, the limited availability of fixed bony landmarks and the potential for fiducial marker displacement can introduce registration errors and reduce accuracy.[16] These anatomical and technical challenges likely contributed to the higher deviation observed in the present study.

Nevertheless, the Synaptive Medical CAS system demonstrated feasibility for guiding minimally invasive equine spinal procedures, including access to the intervertebral foramina and intervertebral discs. Importantly, the mean accuracy achieved in this study (11.33 ± 11.02 mm) falls within the visualisation range provided by standard minimally invasive dilator systems, which typically allow a working corridor of 10 to 25 mm. Therefore, this level of precision may be sufficient to support procedures requiring limited exposure while maintaining navigational safety. Furthermore, preliminary data from our ongoing studies indicate that this accuracy is adequate to enable navigation-assisted minimally invasive approaches in large-animal spinal surgery.

Studies[17] in human medicine have shown that CAS can shorten the learning curve for certain procedures, although greater experience is sometimes required to fully realise its advantages, as reported in total hip arthroplasty.[18] In our study, this is reflected by the shorter procedure times of experienced surgeons compared to those of a user without any experience. Only one study has addressed the CAS learning curve in veterinary medicine, as completed by Santistevan et al.[19] However, in this study, the comparison between experienced and novice surgeons showed statistical significance when comparing the distance from the target on navigation with a system different from the Synaptive Medical CAS system. Nevertheless, our study demonstrated that the Synaptive Medical CAS system is user-friendly despite experience while highlighting the importance of adequate training to achieve proficiency.

This study had several limitations. The small sample size reduced the repeatability and statistical strength of our navigation assessments. The use of previously frozen cadaveric heads and necks likely introduced anatomical distortion due to freeze-thaw cycles, which may have affected accuracy. Image registration also posed challenges, as the system required manual identification of fiducial markers, introducing user-dependent error. In addition, successful registration in all 3 planes (x, y, and z) was difficult, given the lateral cervical anatomy, particularly in achieving consistent alignment in the z-plane. Another limitation involved the instrumentation. Because the Synaptive Medical CAS system is designed for cranial applications, no compatible tools existed for cervical spine navigation, requiring us to fabricate custom instruments for pin placement. Finally, the nonrigid spinal needle used for navigation may have contributed to deviations in trajectory accuracy.

Future research on CAS systems could explore clinical applications to cervical spinal procedures, in addition to investigating more caudal cervical spine segments. Moving more caudally involves thicker musculature and penetration to reach the spinal segments. Understanding how this affects the trajectory and instrumentation needed to reach such depth would be important for clinical application. In this study, targeting the articular process joint and intervertebral foramen was a strategic choice based on common cervical spinal procedures performed at these anatomical areas in equine patients. These procedures include ventral interbody fusions for stabilisation or dorsal laminectomies and much newer endoscopic foraminotomies for decompression to treat the most common spinal cord pathology in horses.[20]

As CAS has been shown to reduce complications in human spine surgery through improved precision and minimally invasive techniques, our goal was to translate these advantages to equine cervical procedures to enhance surgical safety and clinical outcomes. In addition, studies extending to other spinal regions, such as the thoracic and lumbar areas, as well as to other species, should be pursued. Investigating the efficacy of CAS across various species and anatomical regions would provide valuable insights into the system's adaptability and potential limitations in diverse veterinary contexts. Clinically, CAS could be applied to a range of surgical procedures and techniques beyond spinal navigation, including orthopaedic and neurosurgical interventions, where precision and minimally invasive approaches are crucial.

Furthermore, CAS systems hold significant promise for training and education, offering veterinary professionals and students a platform to practice and refine surgical techniques in a controlled, real-time environment.[21] Such training could improve procedural accuracy, reduce learning curves, and ultimately enhance patient outcomes. Expanding CAS's role in veterinary surgery through these avenues would deepen our understanding of its utility and foster its broader adoption in veterinary medicine.

In conclusion, this study demonstrates that a CT-based CAS, adapted from a system originally developed for MRI-guided human neurosurgery, is a feasible and promising tool for equine cervical spine procedures. The Synaptive Medical CAS system enabled accurate navigation to anatomically demanding targets such as the intervertebral foramina, articular process joints, and intervertebral discs, supporting its potential use in minimally invasive spinal interventions. Although further refinement and validation in live subjects are warranted, these findings highlight the system's adaptability to complex spinal anatomy and its translational potential for broader applications in veterinary spinal surgery.

Moreover, the study underscores that CAS technology is accessible to surgeons with varying levels of experience, although structured training is essential to ensure proficiency and optimise performance. Taken together, these results establish a foundation for integrating navigation-guided techniques into equine surgery and advancing precision-based approaches in veterinary medicine.

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Disclosures

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10-11 JULY
SAVA Eastern Free State Branch Mini-Congress
Lavender Hill Country Estate, Bethlehem

31 JUL - 2 AUG
The South African Integrative Veterinary Medicine Conference
Protea Hotel Marriott Techno Park, Stellenbosch

1-2 AUG
Hill's Pet Nutrition Nurses Hybrid Conference
Cradle Moon Lakeside Game Lodge, Muldersdrift

14-15 AUG
SAVA Free State & Northern Cape Branch Mini-Congress
Protea Hotel Marriott, Kimberley

30 AUG - 2 SEPT
54th Annual Parasitological Society of Southern Africa Conference
ATKV Klein-Kariba, Bela-Bela

4-5 SEPT
SAVA Mpumalanga Branch Mini-Congress
Venue TBC, Nelspruit

30 SEPT - 1 OCT
South African Association of Veterinary Technologist Congress
Krystal Beach Hotel, Gordon's Bay

7 OCT
Elanco Salmonella Scientific Symposium
Serengeti Golf and Wildlife Estate, Gauteng

11-13 NOV
Poultry Group of SAVA Biennial Congress
Misty Hills Country Estate, Muldersdrift

1-3 DEC
13th Congress of the Federation of African Immunological Societies
Cape Town International Convention Centre

2027 - 13-15 APR
13th South African Veterinary Association & Para-veterinary Congress
Gauteng

2027 - 8-11 DEC
22nd International Symposium of the World Association of Veterinary Laboratory Diagnosticians
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SAVETCON EVENT MANAGEMENT

Yarns – Part 1 of 10

by Jay Malherbe

Dying Birds



was a very newly qualified vet in the early 70's, and was working for the government as a state vet in the Karoo. The government had paid my university fees, and as a result, I had to work for them as payback.

It was an icy cold day, with snow on the hills, when, with much excitement, someone called in. All the fowls and other birds were dying on this farm. There must be foul play afoot! Off I went in my GG Volkswagen. At least it had an interior heating system. Up into the hills of the Agter Renosterberg with snow all about.

This was, of course, at the height of the 'rooi gevaar ' and 'swart gevaar', so when I got to the farm, there were several police vans already there, along with most of the local top brass- just in case.

Well, there were quite a few dead fowls, a duck, a turkey, some doves and a sparrow. Now I knew very little about poultry. I had passed my two-year poultry course, but with very little enthusiasm.

At least I was a bit better than Lennie, who, only interested in working with horses, was heard to say on learning that he had passed poultry, ' Thank goodness the only chicken I'll ever have to look at from now on will be on the dinner table'.

We found a suitable table in the shed, and with the farmer, police, neighbours and workers all crowded around, I did the first post-mortem. Needless to say, I didn't have a 'cooking clue', as they would say today. Everything looked normal to me. My brain was working overtime to avoid looking like an idiot. I realised there must be a common denominator to all this.

What do you feed the fowls? I wanted to know, as if the post-mortem had led me to this question. Crushed mealies was the reply, so I asked to see the source. At the end of the shed, very near to the ubiquitous Lister generator, was a half drum, full to the top with crushed mealies.

Quite a lot of the mealies at the top appeared damp, and as I smelt them, I thought I smelt diesel. The old fellow who looked after the poultry explained that a new bag of maize had arrived the day before. On tipping the contents into the drum, the bag had split, resulting in some spillage, which he had scooped up into the drum. Close inspection showed that the floor was covered in a thin film of diesel as a result of years of small spills and neglect.

I happily announced 'Cause of death: diesel poisoning, accidental,' much I think to the deflation of the police Officers. I got in my car and went home while the police and neighbours went into the farmhouse for tea.

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‘Don’t forget to have fun’: Top UP Veterinary Science graduate reflects on balance and achievement

Article sources from the University of Pretoria, Department of Institutional Development
Posted on June 04, 2026



Jonathan Wimberley’s recent graduation turned out to be an extra-special double celebration when he received not only his Bachelor of Veterinary Science degree from the University of Pretoria (UP), but was also awarded the Vice-Chancellor and Principal’s Medal for top performance in his graduating class.

Wimberley is one of the more than 13 221 UP students and honourees receiving certificates and honours during UP’s Autumn Graduation season, with ceremonies taking place across all faculties from Monday 4 May to Friday 29 May 2026. He received his degree and medal during the Faculty of Veterinary Science’s graduation ceremony on 19 May 2026.

Wimberley says his path to becoming a veterinarian was shaped from childhood, as his father is a vet. “He did his best to convince me to choose another career path, as did his friends who are also vets – playfully, but also somewhat seriously,” he says.

What began as admiration for the rewards of the profession (along with an understanding of the realities and pressures) developed into a deeper fascination with the science behind veterinary medicine and the impact it can have. After leaving school, he was initially not accepted into UP’s sought-after Veterinary Science programme, but decided to accept the Bachelor of Science placement offered and then reapply, a decision he is thankful for today.

Wimberley says maintaining the right mindset was essential to coping with the demands of his programme. “You have to be in the right frame of mind to absorb the amount of information the degree requires,” he says. “And for me this meant calculating the right balance between work and play. There’s no point burning yourself out during your degree when you have an entire working career ahead to do that,” he quips. “And if you don’t build lasting friendships during your studies, who are you going to call when work gets tough later on?”

Reflecting on his years at UP, Wimberley says the experiences that stand out most are not necessarily those found in lecture halls or laboratories. Instead, they are often those that involve the friendships and adventures that accompany student life.

“Sure, I enjoyed a lot of the theory and practical work, but how can studying compare with memories like attempting to cross the Limpopo River on a donkey cart, cycling across Zimbabwe, living wild in the Okavango Delta, or searching for birds in the Eastern Highlands? Those are the things that stay with you forever,” he says. “The memories of cramming missed content the night before a test are probably better forgotten.”

He advises current and future Veterinary Science students to remember and maintain their genuine interest and enthusiasm for the course matter. “Don’t get so caught up in the stress and workload that you forget to have fun,” he says. “Keep going back to remembering why you chose the profession in the first place, why the career excites you, and what it’ll take to become a capable and compassionate veterinarian.”

He says a key to academic success is always remembering to acknowledge the good things around you. “You will certainly come across some jaded and negative practitioners along the way; don’t be discouraged by this, and certainly don’t think less of them.

Veterinary Science will throw challenges at you daily that most people will never have to face, and that can take its toll on the best of us. Never be too quick to pass judgment, whether it be related to someone else’s attitude or mistakes. It is one of the most humbling professions, and if you’re the one making the mistake, you’ll want others supporting you. It’s important to be there for one another as peers.”

As to what the future holds for Wimberley, he has his sights set on gaining experience and finding adventure, perhaps in the “wilder places of Australia”. For now, though, he’s completing his community service and enjoying being exposed to various fields as he gets a feel for the direction his veterinary science career will take.

“It is a great honour to receive this award from UP, and I would like to thank the University for the opportunity and for the high level of education that I was able to receive through the Faculty of Veterinary Science. Thank you as well to all the lecturers, clinicians, friends and family members who kept me motivated and inspired.

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CALL FOR NOMINATIONS FOR SAVA AWARDS AND HONORARY MEMBERSHIP 2026

DEADLINE: 31 JULY 2026

Nominations for the SAVA Awards are invited. These awards are conferred on persons who have made exceptional and significant contributions in the fields of Veterinary Science, or the Veterinary Profession and they serve as a prestigious form of recognition of distinguished service. They require sufficient but concise justification for the nomination in the category selected, as outlined in the criteria listed for each category. The presentation of awards will be made at a suitable venue and occasion identified by SAVA and this usually occurs every second year to coincide with the Gala Dinner of the SAVA Biennial Congress. Please adhere to the nomination guidelines as set out below.

1. GOLD MEDAL OF THE SAVA

Awarded to any person, in recognition of outstanding and sustained scientific achievement, with a major impact in the field of veterinary science in South Africa. The medal will only be awarded once to a particular person, and there will be one award per year. The award requires a very comprehensive curriculum vitae and motivation.

2. PRESIDENT'S AWARD

Awarded to any veterinarian registered with the SAVC in recognition of outstanding service to and advancement of the veterinary profession in South Africa. The award will only be bestowed once on a particular person, and there will be one award per year. The award requires a very comprehensive curriculum vitae and motivation. .

3. BOSWELL AWARD

Awarded to any member of the SAVA for eminent service rendered to the profession through the SAVA. The award may be bestowed upon more than one person in a particular year.

4. CLINICAL AWARD OF THE SAVA

Awarded to any veterinarian or group of veterinarians who are registered with the SAVC and have excelled in applied veterinary practice. There is a limit of one award per clinical discipline per year. Past recipients become eligible for another award after a period of five years, for a different contribution.

5. RESEARCH AWARD OF THE SAVA

Awarded to one or more veterinarians for a body of research related to Veterinary Science, and published in scientific journals, that has made an important contribution to a particular field of study. Recipients of this award may be eligible for nomination for new original research. Submission to the Awards Committee may be made by candidates themselves.

6. YOUNG VETERINARIAN OF THE YEAR AWARD

Awarded to one veterinarian registered with the SAVC per year, younger than 35 years of age or who has not been registered for longer than 10 years and who has made a significant contribution to veterinary science in his / her work sphere.

7. SOGA MEDAL

Awarded in recognition of exceptional community service rendered by a veterinarian registered with the SAVC or a veterinary student enrolled at a South African veterinary faculty. In addition to veterinary-related services, other forms of community service may be considered to support the nomination.

8. CITATION OF THE SAVA

The SAVA may bestow a citation upon one or more persons, including non-veterinarians, in recognition of specific achievements and / or meritorious contributions to the veterinary profession or the SAVA. More than one citation may be bestowed per year.

9. HONORARY LIFE MEMBER

Any SAVA member who has rendered long and outstanding service to the veterinary profession may be awarded Honorary Life Membership. Honorary Life Membership will not be granted to more than three people in one year.

10. HONORARY ASSOCIATE LIFE MEMBER

Any person who is not a veterinarian and who has rendered outstanding service to veterinary science, or the veterinary profession may be awarded honorary associate life membership. Honorary Associate Life Membership will not be granted to more than three people in one year.

All nominations must be supported by:

- Submissions must be made on the official nomination form available from the SAVA office.
- A brief motivation in terms of the conditions of the specific award, including the impact the work of the nominee has had. Evidence supporting the motivation, such as testimonials, may be included.
- A full *curriculum vitae* of the nominee, including a list of publication(s) where applicable and all the contact details of the nominee.
- Copy (ies) of the relevant publication(s) in the case of the Research Award.
- It should be clearly understood that all SAVA Awards are conferred for contributions that have been made specifically in a South African context and not elsewhere.

Please note that:

- Any member of the SAVA may submit nominations, while others making nominations must include the support and signature of a SAVA member. Nominators are encouraged to channel their nominations via a SAVA Group or Branch.
- Non-SAVA members may be nominated for all categories except the Boswell Award and Honorary Life Membership.
- Unsuccessful nominations of previous years may, at the discretion of the Awards Committee, be held over for consideration in the following year.
- Where the nominator and seconder have indicated their permission, award categories of nominations could be changed by the Awards Committee.
- Members of the Awards Committee are permitted to propose or second candidates for awards, on condition that they recuse themselves when such nominations are discussed.

The onus is on members to submit appropriate nominations by the due date.

Failure to comply with the above will lead to disqualification of the nomination.

All nominations, in electronic format, marked for the attention of Prof G Bath, Chairperson, Awards Committee of the SAVA, must reach the SAVA office, Debbie Breeze by

FRIDAY, THE 31ST JULY 2026

Nomination forms may be obtained from Ms Debbie Breeze 012 346 1150 or please send an email to debbie@sava.co.za

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Greetings, everyone, and I hope winter has been kind to everyone! Veterinary and para-veterinary work is meaningful, demanding, emotional, and often unpredictable. It brings moments of deep satisfaction — but also moments of exhaustion, frustration, grief, and pressure. In this environment, **collegiality is not a "nice to have";** it is one of the foundations of a healthy, sustainable working life.

The need for this conversation is urgent. In South Africa, collegial interactions have been identified as one of the most important contributors to veterinarians' lives, while also being closely linked to how well they cope with workplace stress. At the same time, many professionals in the animal care space are carrying a heavy emotional load: elevated levels of secondary traumatic stress, clinical signs of depression, and even suicidal ideation have all been reported in local and international surveys. That is serious stuff.

But this article is not here to weigh us down. It is here to **remind us that the way we treat one another at work** matters enormously — and that a bit of kindness, humour, patience, and perspective can go a very long way.

What is collegiality? At its simplest, collegiality means the quality of being respectful, supportive, cooperative, and professional with your colleagues. It is about **treating one another with dignity, working together constructively, assuming good intent, helping each other succeed, and creating a workplace where people feel safe enough to ask questions, admit mistakes, and learn**. In veterinary and para-veterinary practice, collegiality includes how you interact with veterinarians, veterinary nurses, animal health technicians, reception staff, kennel staff, students, locums, practice managers, and everyone else who contributes to patient care and client service. In other words: **collegiality is not limited to "the people with the same title as you."** It is a whole-team concept.

Why does collegiality matter? Because **veterinary work is hard enough already.** We are expected to make quick decisions, manage emotionally charged clients, handle suffering and euthanasia, work under time pressure, balance medical care with practical constraints, and often keep smiling while your brain is trying to process twenty things at once. Now add a difficult colleague relationship into that mix, and the day can go from "challenging" to "why did I even get out of bed?"

Good collegiality reduces workplace stress, improves communication, reduces conflict, increases job satisfaction, supports mental wellbeing, improves patient outcomes, and creates a more resilient practice culture. **A team that works well together does not just feel better — it functions better.**

Private practice can be wonderfully rewarding, but let us be honest. It can also be intense. One emergency after another, a client who arrives in full panic mode, a phone that will not stop ringing, an uncooperative patient, a nurse trying to hold it all together, and a vet who has not had lunch but is pretending otherwise. In that kind of environment, people can become short-tempered, reactive, or withdrawn. That does not make them bad people. It makes them human. **Collegiality helps teams remember that your colleague is not the enemy, the pressure is real for everyone, and a little grace can prevent a small issue from becoming a very big one.**

You know a team has **healthy collegiality** when people greet each other properly, communicate clearly, ask for help without shame, offer help without being asked every time, give feedback respectfully, disagree without attacking, and laugh together. Yes, laughter counts. In fact, it is often one of the best pressure valves in a busy practice.

Poor collegiality is sarcasm instead of support, eye-rolling instead of dialogue, gossip instead of problem-solving, blaming instead of understanding, gatekeeping instead of teaching, and "that's not my job" syndrome. When collegiality breaks down, the whole team feels it.

Communication gets worse. Morale drops. Mistakes become more likely. And people start emotionally distancing themselves from the workplace. That is not good for staff, and it is certainly not good for patients.

Ten practical ways to strengthen collegiality in a veterinary or para-veterinary setting:

1. **Assume good intent first**: before reacting to a colleague's tone/behaviour, pause and ask whether they are under pressure, or you misunderstood their message, or maybe it is a bad moment instead of a bad pattern. This can save many unnecessary conflicts.
2. **Speak to people, not about them:** address issues directly and respectfully with the person involved where appropriate. Gossip is fast, but it is rarely productive.

3. **Make room for dissimilar roles**. Everybody contributes uniquely. Respecting different skill sets builds trust. The receptionist who calms the client, the nurse who notices the subtle change, and the vet who makes the final call are all part of the same patient-care machine.
4. **Ask for help early:** you are not required to know everything immediately. A formidable team is one in which asking for help is normal, not embarrassing.
5. **Offer help before being asked:** A simple "Do you want a hand?" can completely change someone's day.
6. **Give feedback kindly and clearly.** Feedback is necessary. But there is a significant difference between "You did that wrong" and "Can I show you a quicker way next time?" One builds learning. The other builds resentment.
7. **Celebrate the small wins.** Not every success is dramatic. Sometimes the win is: a difficult catheter placed successfully, a nervous patient handled gently, a smooth morning surgery list, or everyone making it to lunchtime without an emotional incident. Celebrate those. They matter.
8. **Use humour wisely.** Veterinary teams often survive on a mix of competence, caffeine, and comedy. Light-heartedness can reduce tension — but only if it is kind, inclusive, and not at someone else's expense.
9. **Respect boundaries.** You are not everyone's therapist. Be supportive while still respecting personal limits, working hours, and emotional capacity.
10. **Remember that everyone is carrying something.** The colleague who seems abrupt may be grieving a case, struggling at home, or simply maxed out. We do not always know the full story. A little compassion costs nothing.

Collegiality is not only about workplace niceness. It **is deeply connected to mental health and wellness**. When people feel respected and supported at work, they are more likely to cope better with stress, stay engaged, seek help when needed, and remain in the profession longer. Collegiality can be a protective factor. It is part of building a practice culture where people can thrive rather than merely survive.

A practical mindset shift: try replacing these thoughts:

"Why is my colleague always like this?"	**"What pressure might they be under?"**
"I don't have time for this person."	**"I may not have time, but I still need to be respectful."**
"That's not my problem."	**"How can I contribute to a better outcome?"**
"They should just know better."	**"Maybe they need support, clarity, or experience."**

This does not mean lowering standards. It means raising humanity.

Collegiality is not about pretending everyone is best friends. It is about building a workplace where people can do demanding work together with mutual respect, kindness, and a shared sense of purpose. In veterinary and para-veterinary practice, where the emotional stakes are high and the pressures are real, **collegiality is one of the simplest — and strongest — tools we have.** So, greet your colleagues, thank them, help them, be patient with them, laugh with them when you can, and when the day is long, remember we are all in the same clinic, paddock, theatre, or consulting room together. A little collegiality can make a very big difference.

Next month, we will continue looking at more ideas for improving our quality of life and overall performance both at work and at home.

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Dental Supplements in Small Animal Practice: Separating Evidence from Marketing

Prof Gerhard Steenkamp, Drs Mareli van de Wetering & Michael Ferreira

A Introduction

The South African veterinary market has seen a marked increase in oral health supplements for dogs and cats. These products, typically presented as powders, sprays or feed additives, are marketed as convenient daily solutions to improve oral health, reduce tartar accumulation and, in some instances, to "manage" gingival disease. Their appeal is obvious. They offer a seemingly simple alternative to tooth brushing and professional dental care, both of which require time, compliance and, often, financial commitment from pet owners.

For the practising veterinarian, however, these products present a growing challenge. Clients are increasingly aware of them and often arrive with expectations shaped by persuasive and scientifically framed marketing. The language used is frequently sophisticated, invoking concepts such as microbiome modulation, anti-inflammatory pathways and antimicrobial activity. While these concepts are biologically plausible, there is a recurring and important distinction that must be made: plausibility is not the same as proven clinical efficacy.

Periodontal disease remains fundamentally a plaque-driven condition. A structured bacterial biofilm adheres to the tooth surface, matures over time and, in the absence of disruption, mineralises into calculus. This process initiates gingival inflammation and ultimately leads to progressive periodontal destruction. The central tenet of effective dental care is therefore the mechanical disruption of this biofilm. Tooth brushing, appropriately designed dental diets and certain validated dental chews all share this fundamental mechanism. Any intervention that does not physically disrupt plaque should be regarded as adjunctive at best and insufficient as a primary therapeutic approach.[1]

Many of the currently available dental supplements rely on a relatively small group of recurring ingredients. We evaluated the following four.

1. Brown seaweed (*Ascophyllum nodosum*)

Brown seaweed (*Ascophyllum nodosum*) is one of the few with moderate supporting evidence in veterinary dentistry. Controlled studies have demonstrated reductions in plaque and calculus accumulation, with effects that appear to be systemic rather than local, possibly mediated through alterations in saliva composition or bacterial adhesion.[2]

An important consideration, often overlooked in clinical discussions, is the issue of dose. While individual product formulations frequently do not disclose inclusion rates, review data indicate that effective dosing in experimental and clinical contexts has varied considerably. Reported regimens include administration as part of the daily diet at relatively high inclusion levels, as well as targeted dosing in the region of approximately 27–50 mg/kg body weight per meal.[2] These variations reflect differences in formulation, delivery method and study design, and make direct comparisons challenging.

The key implication for clinical practice is that dose is not incidental but central to efficacy. Even where an ingredient has demonstrated benefit, the magnitude of that benefit is dependent on achieving an adequate and consistent intake. In the absence of transparent dosing information in commercial products, it becomes difficult, if not impossible, to determine whether a product delivers a biologically meaningful quantity. It is therefore reasonable to regard the dosing ranges described in the literature as indicative of minimum effective exposure levels rather than guarantees of efficacy across all formulations. The mere presence of *Ascophyllum nodosum* in a product does not ensure that it is included at a level sufficient to replicate the outcomes reported in controlled studies. This underscores a broader principle in evidence-based dentistry: the presence of an active ingredient, without clear information on dose and delivery, does not allow for meaningful extrapolation of clinical efficacy.

2. Sodium hexametaphosphate

Sodium hexametaphosphate acts by binding calcium in saliva and thereby reducing the mineralisation of plaque into calculus. This mechanism is well established in dental diets. However, it is important to recognise that such compounds do not remove plaque and do not directly address gingival inflammation. Their role is therefore limited to slowing calculus accumulation and remains dependent on concurrent plaque control.

3. Chlorhexidine

Chlorhexidine occupies a unique position in veterinary dentistry as a well-established antimicrobial agent and is often described as the gold standard for chemical plaque control. This designation is supported by extensive human dental literature, most notably the work published in *Periodontology 2000*, which clearly establishes **chlorhexidine digluconate** as the benchmark against which other antiplaque agents are measured.[3] However, this status requires careful qualification. The evidence base is specifically derived from the use of chlorhexidine digluconate at concentrations typically ranging from 0.12% to 0.2%, delivered as oral rinses, bioadhesive gels or professionally applied solutions.The mere presence of "chlorhexidine" on a product label is therefore insufficient to infer clinical efficacy.

Different chlorhexidine salts vary in solubility, bioavailability and retention, and these differences are seldom disclosed. More importantly, the delivery method plays a decisive role. Low-volume oral sprays, which are commonly marketed for convenience, are rapidly diluted by saliva, swallowed and unevenly distributed across oral surfaces. While such formulations may have a transient effect on oral bacterial load and may improve halitosis, they are unlikely to achieve sustained plaque inhibition or exert a meaningful effect on subgingival biofilm. The clinical performance observed in controlled studies cannot simply be extrapolated to these delivery systems.

4. Probiotics and other neutraceuticals

Probiotics and various anti-inflammatory or antioxidant nutraceuticals, including omega-3 fatty acids, co-enzyme Q10 and plant-derived extracts, are also frequently incorporated into these products. While these ingredients may exert systemic or local anti-inflammatory effects and, in some cases, influence microbial populations, the supporting evidence in veterinary dentistry remains limited.[4] Importantly, none of these compounds address the primary aetiological factor in periodontal disease, namely plaque. Their role, if any, should therefore be regarded as supportive rather than therapeutic.

B How to evaluate a product

When evaluating dental supplements, practitioners need to move beyond the ingredient list and critically assess both formulation and claims. The first and most important question remains whether the product meaningfully contributes to plaque control. If it does not, its role in altering disease progression will be limited.

Equally important is the distinction between preventative and therapeutic positioning. Preventative claims, such as 'supporting oral health' or 'reducing tartar accumulation', may be reasonable when supported by appropriate evidence. Therapeutic claims, however, require a much higher level of scrutiny. Phrases such as "management of diseases of the gingiva" or "for gingival conditions" are increasingly encountered in product descriptions. While these may appear subtle, they imply an effect on pathological processes and therefore move the product conceptually into the realm of medicinal claims.

In the South African regulatory framework, this distinction is not merely semantic. Products registered as feeds or nutritional supplements are permitted to support or maintain health but may not claim to treat or cure disease. Claims relating to the treatment or management of disease fall within the scope of the Medicines and Related Substances Act and require formal registration supported by evidence of safety, quality and efficacy.[5] The use of disease-associated terminology in products that are not registered as veterinary medicines is therefore, at best, ambiguous and, at worst, misleading.

A further critical consideration is whether the formulation delivers an effective dose via an appropriate route. As illustrated with both seaweed-based products and chlorhexidine-containing formulations, efficacy is highly dependent on achieving sufficient exposure at the site of action. Without clarity on dose and delivery, it becomes impossible to meaningfully relate a commercial product to published evidence.

From a practical standpoint, this places a clear responsibility on the practitioner. It is necessary to critically evaluate formulations rather than accept ingredient lists at face value, to understand the importance of dose and delivery in determining efficacy, and to guide clients toward interventions that are supported by evidence. This does not preclude the use of adjunctive products, but it does require that they are positioned appropriately within a broader dental care strategy.

C Clinical reality and conclusion

In clinical practice, most dental supplements may offer limited benefits. They may improve oral malodour, modestly slow calculus accumulation and provide some adjunctive support in maintaining oral health. However, they do not replace tooth brushing, they do not obviate the need for professional dental cleaning, and they do not treat periodontal disease. Perhaps the greatest concern is that their use may create a false sense of security, leading to delays in appropriate diagnosis and intervention.

The increasing availability of these products reflects a genuine demand for practical oral care solutions. As veterinarians, our responsibility is not to dismiss them outright, but to interpret them within the framework of evidence-based dentistry and to communicate their limitations clearly and professionally.

In this context, the following is the position of the authors:

In South Africa, products that claim to treat or manage disease must be registered as veterinary medicines under the Medicines Act. Products registered as feeds or supplements may not claim to treat or cure disease and must limit claims to nutritional or supportive functions. The use of wording referring to diseases of the gingiva in a non-registered product is therefore legally questionable and not aligned with the intent of the legislation.

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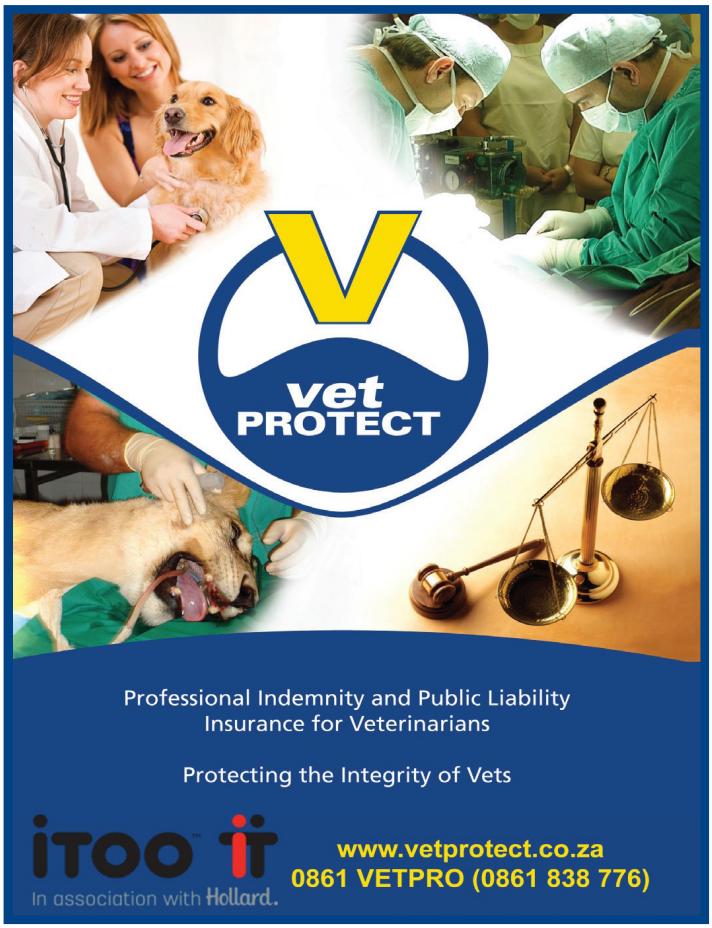
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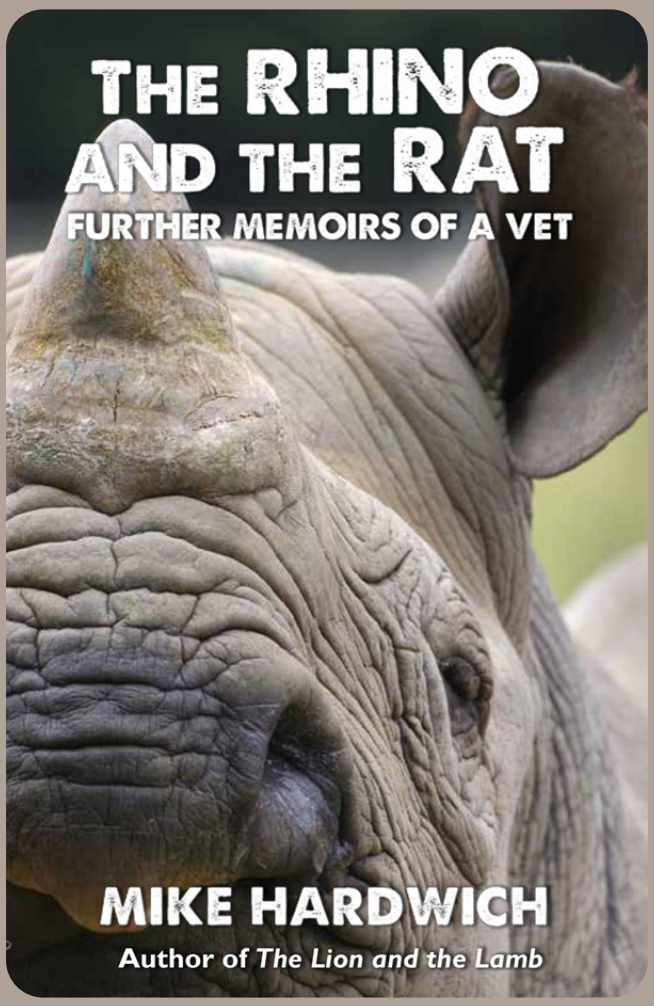
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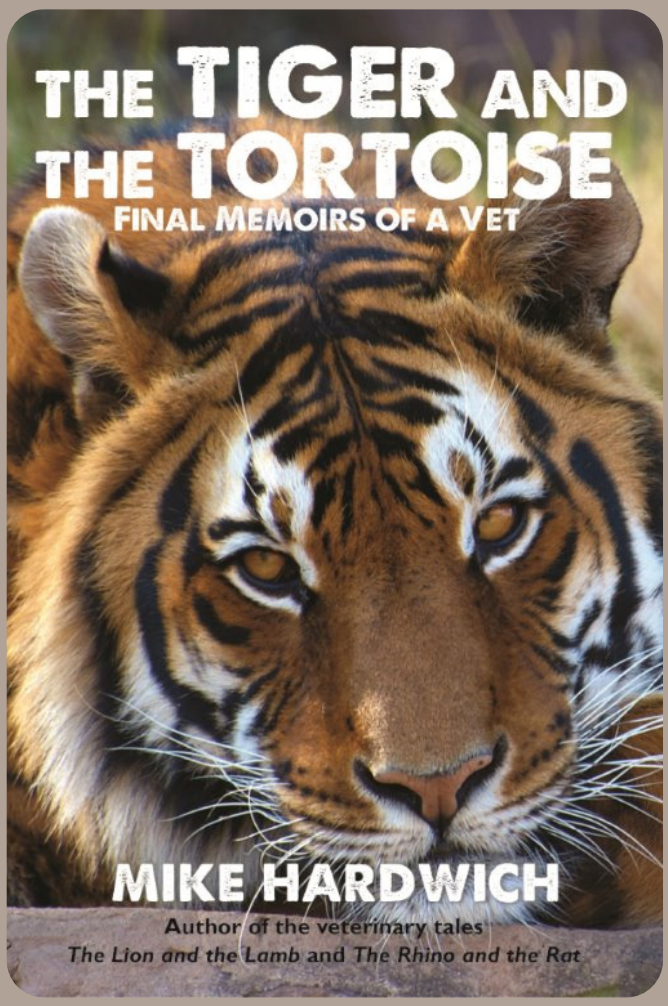
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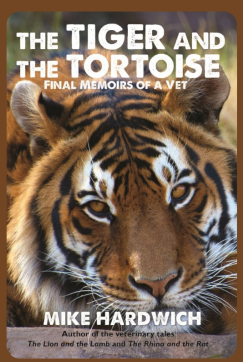




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