Attitudes towards animals and belief in animal mind among first-year veterinary students before and after an introductory animal welfare course

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Abstract

Veterinarians are increasingly looked to for guidance on matters relating to animal welfare, yet little is known about US veterinary students' attitudes and beliefs about animals. In 2019, we surveyed all first-year veterinary students at a major US veterinary college (n = 123) before and after taking a required one-credit introductory animal welfare course. Attitudes were measured using the Pests, Pets and Profit (PPP) scale and belief in animal mind (BAM) was measured using an ad hoc measure adapted from previous work. Pre- and post-course comparisons indicated the introductory animal welfare course had no immediate effect on veterinary students' attitudes or BAM. Veterinary students' attitudes were most positive for animals considered pets, followed by pests and those used for profit. Students believed most species possess a wide variety of mental capacities, including many secondary emotions often considered uniquely human (eg guilt, embarrassment, jealousy). Sociodemographic variables consistently associated with more positive attitudes towards animals were: female gender, vegetarianism and liberal political ideology. Preferring a career involving large or food animal practice was consistently associated with less positive attitudes towards animals. Belief in animal mind explained 3% of the variation in attitude scores, whereas sociodemographic variables explained 49% of variation in attitude scores. Female gender, vegetarianism and preferring small (vs large or food animal practice) were all associated with greater BAM scores. Understanding veterinary student attitudes towards animals and beliefs about the mental capacities of animals is important when evaluating a veterinarian's ability to adhere to their oath.

Keywords: *animal welfare, attitude change, belief in animal mind, education, emotion, veterinary medicine*

Introduction

Social norms regarding animal treatment have changed dramatically during the last 300 years (Pinker 2012). As a result, the veterinary profession is increasingly looked to for expertise and leadership in addressing animal welfare issues. Today, graduates of accredited veterinary colleges in the United States solemnly swear to:

> Use their scientific knowledge and skills, for the benefit of society through the protection of animal health and welfare, the prevention and relief of animal suffering, the conservation of animal resources, the promotion of public health, and the advancement of medical knowledge… and practice my profession conscientiously, with dignity, and in keeping with the principles of veterinary medical ethics (American Veterinary Medical Association [AVMA] 2011).

To help ensure veterinary training reflects this commitment, the AVMA Council on Education now requires all accredited veterinary colleges to provide, "knowledge, skills, values, attitudes, aptitudes and behaviors necessary to address respon-

sibly the health and well being of animals in the context of ever-changing societal expectations" (AVMA 2020).

Understanding veterinary student attitudes towards animals and beliefs about animal mental capacities is important when evaluating a veterinarian's ability to adhere to their oath. Attitudes are considered precursors of behaviour (Fazio 1986), and empirical research suggests strongly held attitudes about animals depend heavily (if not exclusively) on perceptions of animals' mental capacities (Knight *et al* 2004; Gray *et al* 2012).

Unfortunately, there has been relatively little research examining veterinary students' attitudes and beliefs regarding animals. Extant research has focused on student satisfaction with animal welfare coursework, and self-perceived knowledge of and ability to address animal welfare issues (Lord *et al* 2010; Abood & Siegford 2012; Johnstone *et al* 2019), rather than student attitudes and beliefs about animals themselves. Moreover, these studies have been limited to relatively small sample sizes and the

Table 1   Weekly topic schedule for the mandatory one-credit (15-week) 'Introduction to Animal Welfare' course for first year veterinary students.

Week	Topic
1	Course introduction
2	Animal ethics
3	Attitudes towards animals
4	Key concepts in animal welfare
5	Biological health and functioning
6	Guest lecture: Animal welfare and the US swine industry
7	Affective states
8	Natural living
9	Animal welfare assessment
10	No class: Spring break
11	Animal welfare policy
12	Guest lecture: End of life decisions
13	Cruelty, neglect and hoarding
14	Human-animal bond
15	Group project preparation

use of single-item, researcher-generated outcome measures, known to have low (or unknowable) reliabilities (Wanous & Reichers 1996). We are aware of only one study assessing veterinary student attitudes towards animals using validated scales (Hazel *et al* 2011), but this study also had a relatively small sample size (n = 28) and was carried out in Australia, making its applicability to the US context uncertain.

In order to explore these issues, we surveyed first-year veterinary students at a Midwestern veterinary college to assess their attitudes towards animals and belief in animal mind (BAM) before and after completing a required animal welfare course. Although this research was largely exploratory, we formulated the following hypotheses:

• H1: Attitudes towards animals will become more positive after taking an introductory animal welfare course;

• H2: Belief in animal mind (BAM) will increase after taking an introductory animal welfare course; and

• H3a-h: The following sociodemographic variables will be associated with more positive attitudes: (a) female gender, (b) socioeconomic status, (c) liberal political ideology, (d) vegetarianism, (e) childhood pet ownership, (f) urban or suburban living environment, (g) non-farming background and (h) preference for mixed/small animal practice (vs large/food animal practice). Due to lack of previously published research, no *a priori* hypotheses were made regarding sociodemographic factors associated with belief in animal mind.

Materials and methods

Study design

This study was reviewed and approved by Iowa State University Institutional Research Board (#18-489-00). All first-year veterinary students enrolled in a mandatory, one-credit introductory animal welfare course were invited to complete a survey in exchange for course credit. Students received two points for completing the pre-course survey during the first day of class (18 January, 2019) and three points for completing the post-course survey on the final day of class (19 April, 2019). Students opting not to participate could complete an alternative assignment of similar duration to receive these points. Individual responses to pre- and post-course surveys were linked via student-generated passwords. Written consent information explicitly stated participation was voluntary, anonymous and responses would have no impact on the students' final grades. These assurances were verbally reiterated by course instructors (STM and JAR) prior to completing both pre- and post-course surveys. At no point were students made aware of research hypotheses. Instructions simply stated that we were, "interested in hearing your opinions about a variety of animal issues."

Description of introductory animal welfare course

Classroom sessions associated with the one-credit, introductory animal welfare course met for 50 min, one day per week over 15 consecutive weeks. All classroom sessions were video-recorded and made available for all students at the end of each class. Course content was modeled on the AVMA Model Animal Welfare Planning Group recommendations (Lord *et al* 2017). Table 1 provides an outline of the weekly class schedule and topics. The structure of the course was 'flipped', meaning students were assigned to watch pre-recorded mini-lectures, approximately 10–15 min in length, one week prior to each class instead of attending traditional class lectures. Students were responsible for watching these lectures and completing a short, five-question, multiple-choice online quiz consisting of multiple-choice questions to test their comprehension of lecture material before the start of that week's class. Quiz answers were then reviewed at the beginning of class, during which time, students had the opportunity to ask questions relating to that week's material. Remaining class time was dedicated to classroom activities that applied the week's content to a final group project assignment. There were no required readings or discussions; however, optional readings corresponding to weekly topics were provided. Class attendance was optional, allowing students to complete the group activity outside scheduled class time, with the exception of first and last classes when surveys were completed, and two guest lectures (weeks 6 and 12). Attendance was taken for internal course assessment purposes, but we were not able to connect attendance to anonymous surveys.

For the final project, self-selected groups of four or five students were tasked with creating a fictional commercial animal facility scenario, and providing an animal welfare

assessment consultation for this client. Part 1 of the project was a written assignment focused on researching and identifying common animal welfare challenges associated with their identified animal use and species. During Part 2, groups developed practical, evidence-based recommendations aimed at preventing and/or mitigating animal welfare challenges identified in Part 1. During the last week of class, each group delivered a 15-min PowerPoint presentation summarising their findings and responding to questions posed by mock clients played by course instructors (STM and JAR). Project topics varied widely, including commercial dog breeding facilities, animal shelters, various types of livestock and equine operations and a marine mammal research centre, to name a few.

Survey instrument

The survey instrument was developed in Qualtrics and consisted of three sections: attitudes towards animals, belief in animal mind and sociodemographics. The order in which attitudes and BAM sections appeared was randomised, as was the order of all individual items comprising all scales. The sociodemographic section always appeared last, with questions in fixed order.

Attitudes were measured using the Pet, Pest and Profit scale (PPP; Taylor & Signal 2009). The PPP consists of three, ten-item sub-scales (all rated on five-point scales; 1 = strongly disagree and 5 = strongly agree) tapping attitudes towards animals considered pets (eg 'I think of my pet as a member of my family [or would if I had one]'), pests (eg 'Pest species have the right to freedom from pain, injury or disease') and those commonly used for commercial purposes or profit (eg 'It is cruel to keep birds in cages simply to mass produce eggs'). Total PPP scores ranged from 30–150, and 10–50 for each sub-scale, with higher scores indicating more positive attitudes towards animals. Since PPP is a relatively novel instrument, we also administered the more widely used Animal Attitude Scale (AAS; Herzog & Matthews 1997) in order to assess convergent validity between scales. The AAS consists of 20 items (rated on a five-point scale; 1 = strongly disagree and 5 = strongly agree). The AAS scores can range from 20–100, with higher scores indicating more positive attitudes. Sample items included, 'Wild animals, such as mink and raccoons, should not be trapped and their skins made into fur coats' and 'Basically, humans have the right to use animals as we see fit.' The PPP was selected as our primary attitude measure over the AAS, because it allows for attitudes to vary by animal category (Taylor & Signal 2009).

Belief in animal mind was measured using a modified version of the approach taken by Bastian *et al* (2012). Students rated the extent to which seven different animal species (cat, horse, deer, rat, chicken, dog, and cow) possessed the capacity to experience 18 different mental states (anger, fear, sadness, disgust, pleasure, pain, boredom, hunger, happiness, jealousy, embarrassment, shame, pride, grief, love, guilt, empathy and hope). Species were selected to represent common examples from each major animal category (pet, pest and profit). The BAM variable was created by summing participant ratings for all mental states across all species. Thus, the maximum score a

Table 2   Variable coding used for regression analyses of demographic data as reported by first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course.

Variable name	Coding
Female	1 = Yes; 0 = No
Socioeconomic status	1 = Low status; 10 = High status
Liberal	1 = Very conservative; 7 = Very liberal
Rural	1 = Rural; 0 = Urban/Suburban
Farm*	1 = Yes; 0 = No
Pet as child	1 = Yes; 0 = No
Vegetarian	1 = Yes; 0 = No
Mixed	1 = Mixed animal; 2 = Large/Food
Small	1 = Small animal; 2 = Large/Food
Other	1 = Other; 2 = Large/Food

* Household raised animals for food.

participant could receive would be seven species × 18 mental states × seven possible points each = 882 total possible points.

Sociodemographic questions were selected on the basis of previous research and included: gender, political ideology, diet (ie vegetarian), childhood pet ownership, current pet ownership, preferred practice type, socioeconomic status, grew up on a farm and living environment (urban, rural or suburban). The pre- and post-course questionnaires were identical except the latter omitted sociodemographic questions to avoid redundancy.

Statistical analysis

Data analysis was undertaken in R version 3.2.0 (R Core Team 2017). Prior to analysis, all negatively worded items were reverse-scored. Internal consistency of scales was assessed using Cronbach's alpha. Pearson's r was used to test convergent validity between scales. Paired Student's t-tests were used to test for equivalency between pre- and post-course attitudes. One-way ANOVA with Tukey HSD tests were used to assess differences in belief in animal mind by species.

A series of multiple regression models were constructed to test hypotheses regarding sociodemographic variables and attitude towards animals (H3a–h). Several explanatory variables were recoded beforehand to ensure ample cell size and ease interpretation (Table 2). Statistical assumptions (independence of residuals, variance homogeneity, residual normality and multicollinearity) were assessed by inspection of residual plots and variable inflation factors using R's *plot* and *vif* (car package) functions. Significance levels for all statistical tests were declared at $P < 0.05$.

Table 3   Sociodemographic characteristics of first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course.

Characteristic	Mean (± SD) or %
Age	24 (± 3.4)
Gender	
Female	85%
Male	15%
Socioeconomic status[†]	6.1 (± 1.5)
Political ideology[‡]	
Conservative	44%
Centrist	20%
Liberal	36%
Living environment	
Rural	48%
Suburban	41%
Urban	11%
Household raised food animals	44%
Pet as child	93%
Pet now	75%
Vegetarian	8%
Career preference[§]	
Food/Large animal	33%
Mixed practice	24%
Small animal	24%
Other	18%

[†] Mean of two items comprising MacArthur Scale of Subjective Socioeconomic Status Subjective (Adler & Stewart 2007);
[‡] Seven-point scale collapsed (1–3 = Conservative, 4 = centrist, 5–7 = Liberal);
[§] Collapsed from drop-down menu with 17 options.

Results

All students enrolled in the course completed the survey; however, data from two students were excluded from analysis due to failure to recall their passwords, essential for linking the pre- and post-course responses. Hence, the final sample was n = 123, consisting of 85% female with mean (± SD) age of 24 (± 3.4); (Table 3).

Order of presentation for attitudes and BAM sections had no effect on responses ($P > 0.05$), indicating order randomisation was successful. Cronbach's alpha estimates for all scales were very high: total PPP scale (0.91), PPP_{PET} (0.93), PPP_{PEST} (0.93) PPP_{PROFIT} (0.86) and AAS (0.91). The mean (± SD) score for total PPP and AAS was 110.52 (± 17.53) and 58.63 (± 4.79), respectively. Sub-scale scores were as follows: PPP_{PET} (M = 47.02 [± 4.97]), PPP_{PEST} (M = 32.03 [± 4.83]), and PPP_{PROFIT} (M = 26.48 [± 7.70]). The inter-scale correlation coefficient for total PPP and AAS was $r = 0.49$ ($P < 0.01$) indicating 'moderate' degree of convergent validity (Lyons-Thomas *et al* 2014). Significant positive inter-scale correlations or tendencies of varying strengths were found between AAS and all PPP sub-scales: Pet ($r = 0.24$; $P < 0.09$), Pest ($r = 0.31$; $P < 0.05$) and Profit ($r = 0.54$; $P < 0.01$).

Paired Student's *t*-test showed pre- and post-course attitudes did not differ (all P's > 0.10; Table 4). Post-course BAM scores differed by species ($F_{6,854} = 15.62$; $P < 0.001$; Figure 1). *Post hoc* Tukey test showed all Pet species (dog, cat and horse) were associated with consistently higher BAM scores than Pest (rat) and Profit (cow, chicken) species (all P's < 0.05). Belief in animal mind scores and total PPP scores were positively correlated ($r = 0.51$; $P < 0.01$). Mean response ratings for each species and mental capacity are found in Table 5 (see supplementary material to papers published in *Animal Welfare:* https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). Female gender ($\beta = 116.55$), vegetarianism ($\beta = 107.76$) and preferring small (vs large or food animal practice) ($\beta = 84.46$) were all associated with greater BAM scores (all P's < 0.05).

Multiple regression analyses testing for sociodemographic associations are presented in Table 6. Total PPP scores were positively associated with female gender, liberal political ideology and vegetarianism whereas having large/food animal career preference was associated with more negative attitudes (Figure 2). Being female was associated with more positive attitudes in all models except PPP_{PROFIT} ($P > 0.10$; H3a). Neither socioeconomic status (H3b) nor living environment (H3f) were associated with any outcome measures. Liberal political ideology was positively associated with more positive attitudes in all models except PPP_{PET} (H3c). Vegetarianism was positively associated with total PPP ($\beta = 0.31$; $P < 0.05$) and PPP_{PROFIT} ($\beta = 0.65$; $P < 0.05$), but was not associated with PPP_{PET} or PPP_{PEST} (H3d). Growing up on a farm was associated with lower scores on PPP_{PROFIT} ($\beta = -0.27$; $P = 0.02$), but exhibited no relationship with PPP_{PET} or PPP_{PEST} (H3g). Students indicating a career preference to work predominantly with large/food animal practice was associated with less positive attitudes in all models (all P's < 0.05); (Table 6; H3h). A final model including sociodemographic factors explained 49% of total variance in PPP scores. The addition of BAM scores explained an additional 3% of unique variance.

Table 4   Mean (± SD) pre- and post-scores and paired *t*-test results for total PPP and PPP_{PET}, PPP_{PEST}, PPP_{PROFIT} sub-scales (Taylor & Signal 2009) and belief in animal mind, as reported by first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course.

| Scale	Mean (± SD) pre-course	Mean (± SD) post-course	*t*-value	*P*-value
PPP	110.5 (± 17.5)	110.6 (± 18.3)	−0.10	0.92
PPP$_{PET}$	47.0 (± 5.0)	47.5 (± 5.5)	−1.41	0.16
PPP$_{PEST}$	32.0 (± 4.8)	36.7 (± 9.3)	0.86	0.39
PPP$_{PROFIT}$	26.5 (± 7.7)	26.5 (± 7.6)	0.09	0.93
BAM	611.9 (± 140.2)	630.6 (± 147.4)	−1.84	0.06

Figure 1
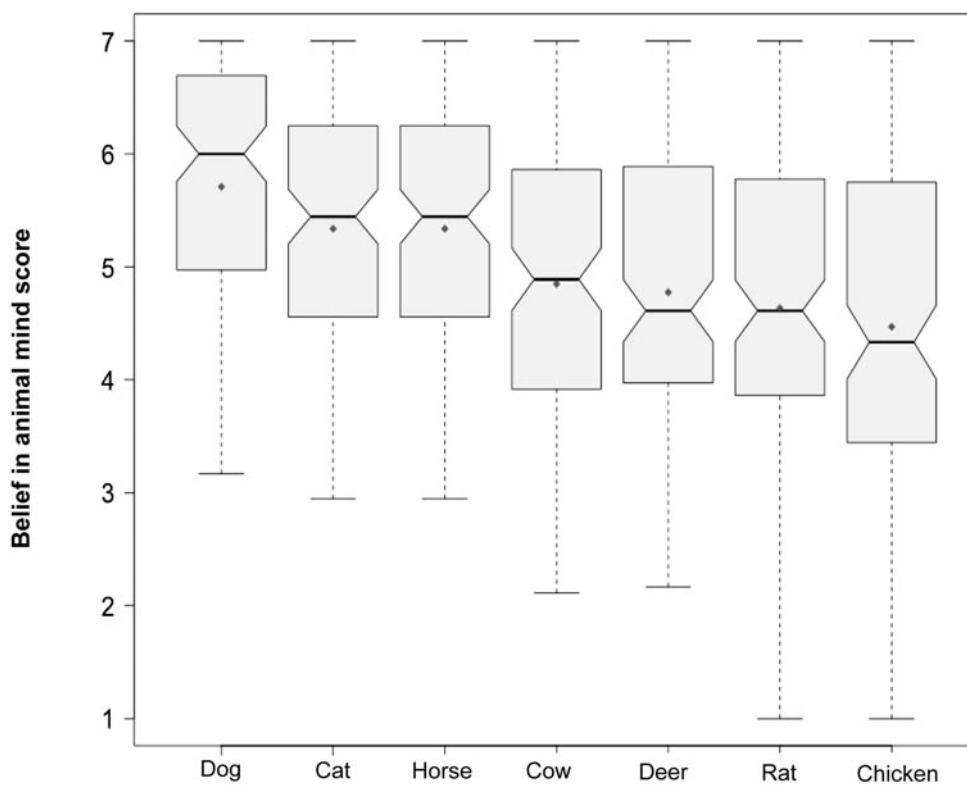
Notched boxplots showing post-course belief in animal mind scores by species, as reported by first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course. Diamond symbol represents mean response on a seven-point scale scaled for each species across all 18 mental capacities. Notched area represents confidence interval around the median ± 1.58 × IQR/sqrt(n).

Discussion

The current study relied on the PPP scale (and its constituent sub-scales) as the primary measures of first year veterinary student attitudes towards animals. Internal consistency of scales was very high and comparable to those found in prior studies (Cronbach's alpha > 0.85 for all scales; Taylor & Signal 2006, 2009; Hazel *et al* 2011); however, the inter-scale correlation between total PPP and the more widely used AAS was only modest ($r = 0.49$). The profit sub-scale was most strongly correlated with the AAS, suggesting the AAS may be biased towards attitudes about animals commonly used for profit.

Veterinary student attitudes were most positive for pets, followed by pests and profit animals. This same pattern was also found in a previous study of veterinary and animal science students in Australia (Hazel *et al* 2011). Mean pet sub-scale scores (47) were also within the range reported in this previous study (46–48); however, both pest (32 vs 34–38) and profit (26 vs 30–32) were lower in our sample. A general population study also found attitudes towards pets were most positive, followed by profit animals and pests (Taylor & Signal 2009). That attitudes are consistently most positive for pets is not surprising given they often attain in-group membership status (Amiot *et al* 2016); however, the

Figure 2
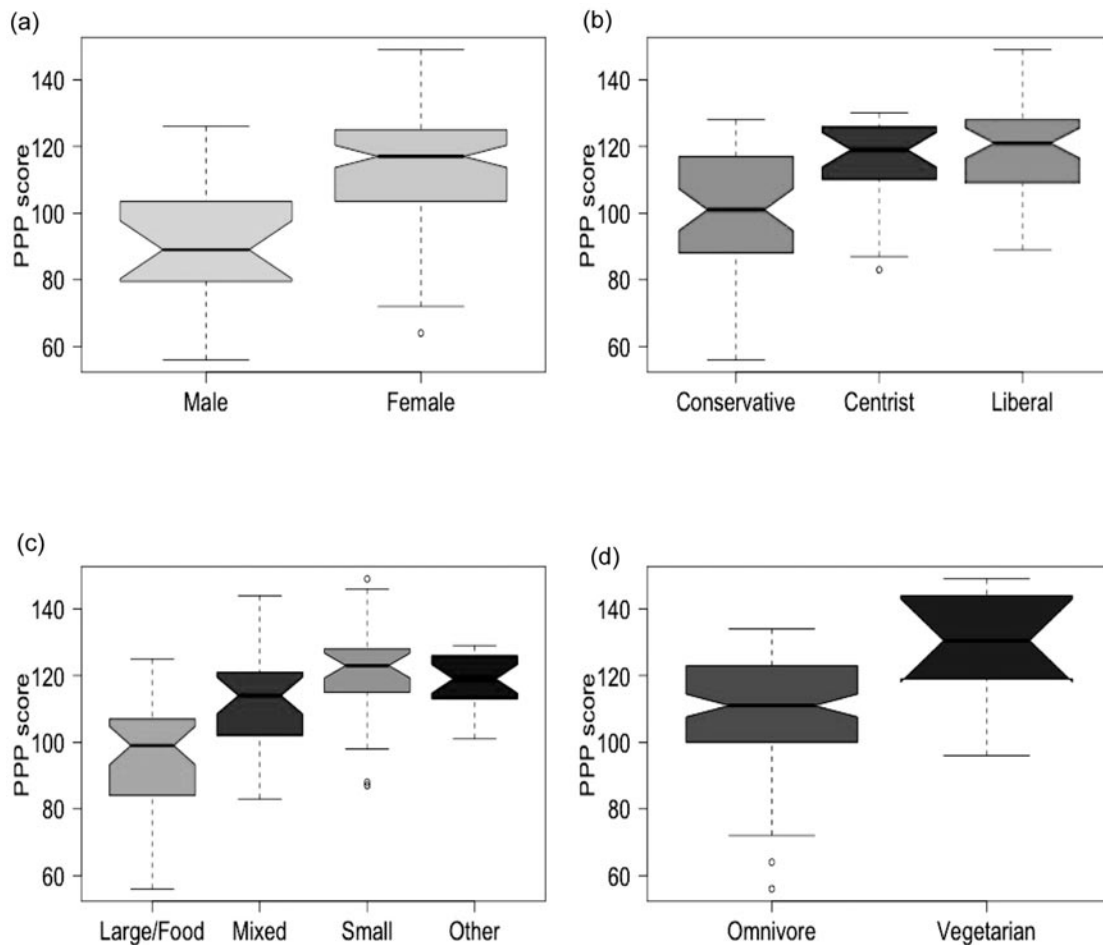
Notched boxplots showing associations (*P* < 0.10) between pre-course overall Pet, Pest and Profit scale (PPP) as reported by first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course and sociodemographic characteristics for (a) Gender, (b) Political ideology*, (c) Career preference and (d) Dietary preference. Notched area represents confidence interval around the median ± 1.58 × IQR/sqrt(n). Open circles represent outliers either > 1.5 times the inter-quartile range above the third quartile or below the first quartile. * Political ideology is represented as categorical to simplify presentation, but in all statistical models it is treated as a continuous effect

discrepancy between veterinary and non-veterinary respondents with respect to attitudes towards profit animals and pests, merits further exploration.

Students reported a wide variety of mental capacities in all species they were asked to consider, including many secondary emotions (eg guilt, embarrassment, jealousy) which some theorists consider uniquely human (Morris *et al* 2008). This suggests anthropomorphism may be relatively widespread among first year veterinary students. It is also interesting to note the relative ordering of animal mental capacities tracks attitudes toward different animal categories. Students perceived dogs, cats and horses (pets) as more capable of experiencing a wider array of mental capacities than cows, deer, chickens and rats (pests and profit). Despite this correspondence, sociodemographic variables explained much more variation in attitude scores (49%) than did belief in animal mind (3%), suggesting attitudes may be influenced by much more than beliefs about animals' mental capacities.

We did not find evidence of attitude change as a result of taking the introductory animal welfare course. This is at odds with Hazel *et al* (2011) who found total PPP, Pest and Profit (but not Pet) scores became more positive after taking a three-credit animal welfare course. Animal science students enrolled in the same course showed no evidence of attitude change. A more recent study of third-year US veterinary students found no difference in the degree of 'professional responsibility' felt for animal welfare after taking a two-credit animal welfare course (Johnstone *et al* 2019). A study of Turkish veterinary students found attitudes actually became more negative after taking an animal welfare course, however; the authors note the timing of the course was confounded with the initiation of clinical practice (Cavusoglu & Uzabaci 2021). Within other professional programmes, such as medicine and business, the impact of coursework on attitudes has also been mixed, with some studies showing change and others finding none (Wynd & Mager 1989). Clearly, more research is needed to understand the effect coursework has on student attitudes.

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Table 6 Results of multiple regression models testing associations between sociodemographic characteristics and pre-course total PPP and PPP_PET, PPP_PEST, PPP_PROFIT sub-scales (Taylor & Signal 2009) as reported by first year veterinary students (n = 123) enrolled in a mandatory one-credit (15-week) 'Introduction to Animal Welfare' course.

	Total PPP		PPP_{PET}		PPP_{PEST}		PPP_{PROFIT}	
	β	*P*-value	β	*P*-value	β	*P*-value	β	*P*-value
Female	*11.21*	*< 0.01*	*4.41*	*< 0.001*	*5.54*	*< 0.01*	1.25	0.37
Socioeconomic status	−0.44	0.59	−0.25	0.39	−0.05	0.92	−0.14	0.68
Liberal	*3.08*	*< 0.001*	0.21	0.45	1.36	0.06	*1.51*	*< 0.0001*
Rural	2.67	0.38	1.71	0.12	1.87	0.30	−0.91	0.47
Farm	−3.65	0.24	0.26	0.82	−1.03	0.57	*−2.88*	*< 0.05*
Pet as child	6.10	0.20	−0.08	0.96	4.66	0.08	1.51	0.44
Vegetarian	8.59	0.10	−1.41	0.38	3.31	0.21	*6.68*	*< 0.001*
Mixed (vs Large_Food)	*8.52*	*< 0.05*	0.56	0.65	3.43	0.09	*4.53*	*< 0.01*
Small (vs Large_Food)	*15.4*	*< 0.0001*	*2.94*	*< 0.05*	*6.49*	*< 0.01*	*5.96*	*< 0.001*
Other (vs Large_Food)	*11.67*	*< 0.01*	*3.40*	*< 0.05*	*6.63*	*< 0.01*	1.65	0.28

All *P*-values < 0.05 are in ***bold italics***.

We can only speculate as to the possible reasons for the lack of course effects on student attitudes towards animals. It may be the case that students who have chosen a career in the veterinary profession have already established attitudes towards animals, and these may be resistant to change. It is also possible ceiling effects may have contributed (eg mean item rating scores on pet sub-scale was 4.7 out of 5) to the lack of significant change. An alternative course structure (eg more credits/hours, fewer students, etc) and/or content could lead to different results. It is, however, important to note the course was never intended to modify student attitudes or belief in animal mind, but rather to provide a broad overview of the field of animal welfare. It is also possible the small amount of curricular time allocated for animal welfare (50 min week for 15 weeks), relative to students' other course requirements, and the unique hybrid delivery format, may have caused students to view the course as less important.

We found female students generally had more positive attitudes towards animals and greater belief in animal mind scores. This is consistent with a large body of anthrozoological literature showing females tend to be more concerned about animal welfare (Herzog 2007; Amiot & Bastian 2015). Multiple studies have found increased concern for animal welfare among female veterinary faculty (Heleski *et al* 2005) and students (Serpell 2005; Hazel *et al* 2011; Cavusoglu & Uzabaci 2021). Most recently, Clarke and Paul (2019) found female veterinary students in the UK also had greater belief in animal mind than their male counterparts. Other studies of non-veterinary populations have failed to find an association between sex and belief in animal mind (Knight *et al* 2004; Morris *et al* 2012; Menor-Campos *et al* 2018). Variation in how belief in animal mind is measured across studies makes

it difficult to draw strong conclusions about the relationship between sex and belief in animal mind.

These gender differences could explain differences in professional behaviour regarding animal welfare. Multiple studies of practicing veterinarians have found female veterinary practitioners are more likely to provide pain relief for many common injuries and surgical procedures (Dohoo & Dohoo 1996; Raekallio *et al* 2003; Weber *et al* 2012; Beswick *et al* 2016; but see Hewson *et al* 2006, 2007 and Keown *et al* 2011). Although research into more proximate causal mechanism(s) is limited, there is evidence differences in empathy mediate the association between gender and attitudes (Paul & Podbercek 2000; Colombo *et al* 2017; Graca *et al* 2018). Future research should more closely examine the relationship between empathy and belief in animal mind.

We did not find evidence of an association between socioeconomic status and attitudes towards animals. This is at odds with predictions of the 'underdog hypothesis' which stipulates persons occupying lower social status find it easier to empathise with animals and thus view them more favourably (Kendall *et al* 2006). It is worth pointing out initial support for this hypothesis was based on correlations between objective measures of socioeconomic status (eg education and income) and researcher-generated measures of attitudes towards animals. Our study utilised a subjective measure of socioeconomic status (ie McArthur Subjective Socioeconomic Status scale) and validated scales to assess attitudes. Regardless of these methodological differences, this is an intriguing hypothesis that merits further testing.

With the exception of attitudes towards pets, liberal political ideology was consistently associated with more positive attitudes towards animals (H2c). In a survey of US veteri-

nary faculties, Heleski *et al* (2005) found attitudes towards animals were positively associated with liberal political ideology. The specific reason(s) for this ideological difference is not clear, but may be attributable to underlying value differences. Moral psychology research has shown the moral judgments of liberals are primarily based on concerns about harm and fairness, whereas conservatives base their judgments on a more expansive suite of concerns including: concerns about loyalty, authority, sanctity and liberty (Graham *et al* 2009, 2013). Less positive attitude scores among more conservative students could reflect greater attention to these concerns.

Generally speaking, childhood pet ownership was not associated with attitudes towards animals (H3e), although there was a tendency for childhood pet ownership to be associated with more positive attitude towards pests. Taylor and Signal (2006) also did not find an association between current or past companion animal ownership and attitudes towards animals. Hazel *et al* (2011), however, reported current pet ownership was associated with more positive attitudes towards pets, but not attitudes towards pests or those used for profit.

Scholars have hypothesised pets might function as 'animal ambassadors', whereby interacting with them facilitates more positive attitudes and relationships toward a wider range of animals (Paul & Serpell 1993). Recent experimental work suggests this may occur by enhancing feelings of closeness and connectedness with animals and reducing intergroup anxiety (Auger & Amiot 2019). Empirical support for this hypothesis in the general population is equivocal, with some studies showing pet ownership to be associated with greater concern for animal welfare (Driscoll 1992; Chun *et al* 2010), and others finding no such association (Taylor & Signal 2006). The lack of association between childhood pet ownership observed in this study may have been a combined result of ceiling effects (mean item rating scores on pet sub-scale was 4.7 out 5) and insufficient variability (eg 93% of students had pets as children). If there is an effect of pet ownership on attitudes, it could be specific to the type of pet; information which we did not collect.

Preferring to work in mixed or small animal practice was associated with greater belief in animal mind and more positive attitudes in almost all models (H3h). This is consistent with Hazel *et al* (2011) who also found students planning to work with food animals had fewer positive attitudes towards animals. Lord *et al* (2010) found being primarily interested in small animal medicine predicted enrollment in an elective animal welfare course. Heleski *et al* (2005) reported greater concern for animal welfare among veterinary faculties with a small animal emphasis versus those with a large or food animal focus. Another study of US veterinary college students found those with preferences to go into small animal practice rated many common veterinary surgical procedures as more 'inhumane' relative to students aspiring to work with food animals (Levine *et al* 2005). A recent study of Turkish veterinary students reported students who had owned and/or dealt with food animals had more negative attitudes toward farm animal welfare (Cavusoglu & Uzabaci 2021). It appears as

though there are consistent differences in attitudes between small and large animal-focused veterinary students.

Caution is recommended when drawing general inferences based on the results of this study. The representativeness of our sample is difficult to ascertain since population level data are not available for most of the other variables we examined (eg socioeconomic status, political ideology, career preference, dietary preference, etc). Our sample is largely reflective of the general US veterinary student population in some respects (ie gender) and unrepresentative in others (ie our sample had more than two times the proportion of students from rural backgrounds; Association of American Veterinary Medical Colleges [AAVMC] 2020). Since the course was taken by all first-year students, it was not possible to recruit a control group. When feasible, future research should consider the inclusion of a control group. This would allow for drawing stronger inferences about the effect of coursework. It is also not possible to comment on the representativeness of our intervention. Many veterinary colleges offer some form of animal welfare coursework, but little is known about the specific structure and content of these courses (Shivley *et al* 2016; Lord *et al* 2017). It is quite possible a different animal welfare course offered to a different sample of students may have different impacts.

Given the idiosyncratic nature of college courses, drawing general conclusions about impacts of animal welfare coursework are likely to remain difficult. This general lack of intervention standardisation is exacerbated by the unique, interdisciplinary nature of animal welfare, which includes the sciences of ethology, physiology, animal science, neuroscience, economics, psychology, sociology, engineering, but also philosophy and ethics. Given this inherent diversity and variability, a more fruitful approach to studying the impact of animal welfare education research could consist of identifying and testing the impact of specific course design features, such as the relative amount of scientific vs ethical content, course delivery modality (online or in-person), group work and/or the extent to which courses require students to scrutinise their existing attitudes and beliefs. Such a research programme could provide more generalisable empirical data to aid in the development of animal welfare courses that meet the needs of the veterinary profession and society.

Animal welfare implications and conclusion

Veterinarians play a tremendously important role in addressing growing societal concerns regarding animal welfare. According to the AVMA Council on Education (2020), the veterinary curriculum must provide, "knowledge, skills, values, attitudes, aptitudes and behaviours necessary to address responsibly the health and well being of animals in the context of ever-changing societal expectations." Rigorous social science research will be needed to assess the extent to which animal welfare education addresses these goals. We have described the results of examining first year veterinary student attitudes towards animals and belief in animal mind. We did not find strong evidence that completing an introductory animal welfare course impacted student attitudes towards

animals or belief in animal mind. Being female, vegetarian and expressing a career preference for a small animal practice were all consistently associated with more positive attitudes towards animals and greater belief in animal mind. Liberal political ideology was also associated with more positive attitudes towards animals, but not belief in animal mind. Students attributed a wide variety of mental states to all animals including many considered 'uniquely human.' Much more research is needed to understand specific factors influencing veterinary student attitudes and belief in animal mind, and how these might change as they move through the veterinary curriculum and transition into their careers.

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