

Empathy towards animals and belief in animal-human-continuity in Italian veterinary students

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Abstract

Empathy towards animals and beliefs in animal-human continuity appear to play an important role in shaping the human-animal relationship and in determining the way animals are treated and cared for. Veterinary medicine plays a central role in animal welfare and has been recognised as a highly caring profession, especially in companion animal practice: however, a number of studies have indicated that veterinary students show a decline in empathy towards animals and an increasing tendency to see them in Cartesian terms as they progress through veterinary education. In the present study we used the Animal Empathy Scale and the Human-Animal Continuity Scale to investigate empathy towards animals and beliefs in animal-human continuity in a sample of first-year ($n = 131$) and final-year ($n = 158$) veterinary students of the University of Milan, Italy. Results revealed a difference in empathy towards animals, with first-year students scoring significantly higher than those at the end of their academic training. This variation in empathy over time emerged in both male and female students, however females always had higher empathy scores than males. Moreover, veterinary students at the end of their course reported a more instrumental attitude toward animals, more pronounced in males than in females. Similarly, there was a difference in the perception of continuity between humans and animals which was more evident in males, with first-year students scoring higher than fifth-year students in some items. Results are discussed in relation to previous studies carried out in other countries and, given the importance of empathy in the veterinary profession, potential reasons underlying its apparent decrease are considered.

Keywords: animal welfare, empathy, gender differences, human-animal continuity, veterinary medicine, veterinary students

Introduction

In recent years increasing attention has been paid to the welfare of animals. Domestic pets as well as farm, research and wild animals have all come under the microscope as have the factors influencing human-animal interactions (eg Taylor *et al* 2004; Serpell 2005; Signal & Taylor 2006; Sherman & Serpell 2008; Meyer *et al* 2014).

It has been shown that empathy towards animals, anthropomorphism (ie the tendency to attribute mental states and emotions similar to our own to other species) and beliefs in animal mind and sentience play an important role in shaping both concern for animal welfare and the human-animal relationship (Hills 1993; Serpell 2003; Butterfield *et al* 2012). There is also agreement that these three factors are inter-linked (Hills 1995; Knight *et al* 2004; Apostol *et al* 2013).

The term empathy, used colloquially to indicate the capacity for people to understand and share the feelings of others (either conspecific or not), refers to a complex multidimensional psychological process, comprising both emotional and cognitive components (Davis 1980; Preston & de Waal

2002; de Waal 2008; Dziobek *et al* 2008); the former involves affective resonance with others' emotions and the generation of an appropriate emotional response, while the latter includes abilities such as recognising and understanding another's emotions and feelings (Taylor & Signal 2005) and perspective-taking (Baron-Cohen & Wheelwright 2004; Schulte-Rüther *et al* 2008).

As a whole, empathy allows an individual to relate quickly to the emotional state of other individuals and has visible effects on overt behaviour: the understanding of others' suffering is characterised by a negative experience, which can lead both to prosocial behaviour, namely a behavioural effort to alleviate the distress of others and promote their welfare (de Waal 2008; Knafo *et al* 2008), and to personal distress, ie an excessive arousal that elicits defensive behaviours or strategies of affective control (Decety & Lamm 2011).

There is evidence that the empathic response is amplified by similarity (for example, in appearance, racial group and personality) and familiarity (social closeness and previous positive experiences), and is suppressed in relation to

strangers and defectors (de Waal 2008; Westbury & Neumann 2008; Drwecki *et al* 2011). In particular, similarity bias seems to play a central role in the evolution of empathy toward animals, which is triggered by animals' signals, behaviours or physical features that closely resemble human characteristics that arouse empathy among humans (Würbel 2009).

Anthropomorphism and belief in animal mind may enhance empathy towards animals acting through the similarity bias and by increasing the perception of human-animal continuity in terms of having awareness, thoughts and feelings (Hills 1995; Butterfield *et al* 2012; Apostol *et al* 2013).

Research has demonstrated that anthropomorphism varies with a species' genetic relatedness to humans (Hills 1995; Harrison & Hall 2010), or with phylogenetic similarity: since this effect emerges also in relation to empathy (Westbury & Neumann 2008; Priguda & Neumann 2014), Harrison and Hall (2010) suggested that anthropomorphism could be considered the highest expression of the cognitive component of interspecific empathy.

Recently, Apostol and colleagues (2013) found a correlation between belief in animal mind and the cognitive component of empathy toward animals and hypothesised that "anthropomorphic interpretations could facilitate the perspective taking process which, in turn, may lead to the affective empathic reaction".

So far, a number of studies, based mainly on questionnaires and validated scales, have investigated how empathy towards animals, anthropomorphism and belief in animal mind are influenced by variables such as gender (Paul & Podberscek 2000; Taylor & Signal 2005; Ellingsen *et al* 2010), culture or religion (al Favez *et al* 2003; Phillips *et al* 2012), eating habits (Filippi *et al* 2010; Rothgerber 2014), education and specific knowledge and training (eg Paul & Podberscek 2000; Levine *et al* 2005; Fischer & Tamioso 2013; Phillips 2014).

In general, females tend to be more empathic and show more concern for other individuals, both human and non-human beings (Davis 1980; Paul & Podberscek 2000; Baron-Cohen & Wheelwright 2004; Signal & Taylor 2007; Ellingsen *et al* 2010), and show greater concern for their welfare and suffering than males (Heath & Lanyon 1996; Capner *et al* 1999; Serpell 2005; Hazel *et al* 2011).

There is also evidence that education and specific training may influence empathy towards people and other animal species. In particular, there are studies showing that health professionals and medical students undergo a process of hardening and appear to become more cynical as they progress in clinical experiences and medical education, showing a decline in empathy (eg Austin *et al* 2007; Hojat *et al* 2009; Neumann *et al* 2011; Nunes *et al* 2011).

Similar findings have been reported for veterinary students with respect to empathy and attitudes towards animals, which appear to be impaired by veterinary education (O'Farrell 1990; Hellyer *et al* 1999; Paul & Podberscek 2000; Levine *et al* 2005).

Besides empathy, in veterinary medicine, anthropomorphism and belief in animal mind and sentience are also issues of particular interest, due to their link with empathy toward animals and to their role in promoting and maintaining our respect, care and compassion for other species (Harrison & Hall 2010).

Paul and Podberscek (2000) investigated veterinary students' empathy towards animals and their beliefs concerning the sentience of animals at two British universities. Comparing students of the first pre-clinical year, the first clinical year and the final year, they reported a decline in empathy toward animals (dogs, cats, cows and pigs) in students of the later years, with a particular involvement of the cognitive component: as the veterinary course proceeded students 'counter-anthropomorphised' animals and tended to see them in more Cartesian terms, as machine-like and having less capacity for consciousness. In particular, it emerged that students in their later years rated the sentience of animals as lower than students in their earlier years, so that animals were considered able to feel hunger and pain but not to experience complex feelings, such as boredom. Moreover, the authors reported that among male students, empathy toward animals decreased over time, so they were less compassionate about animal hunger and pain, as well as fear and boredom, at the end of their training. These results were consistent with those obtained in a previous study by Hellyer *et al* (1999), which showed that fourth-year veterinary students in the US were less likely to treat animal pain than second- or third-year students.

More recently, Levine *et al* (2005) assessed veterinary students' perceptions of the cognitive abilities of different domesticated species in one North American Veterinary College, reporting that 90% of them believed that dogs and cats had cognitive abilities and were able to experience emotions, while the percentage of students believing in cognitive abilities and sentience of farm animals was lower, with less than a half believing poultry had cognitive processes. As the author noticed, students' beliefs about farm animals' cognition and emotions were inconsistent with current scientific evidence and this ignorance regarding the mentality of domestic species represented a cause of concern as to how these future veterinarians would have promoted animal welfare: in fact, in this study it also emerged that students considered painful procedures, such as hot branding and castration without anaesthesia or analgesia, suitable for cows, small ruminants and pigs, but not for dogs and cats.

Taken together, these studies on veterinary students depict a potentially worrying situation, since a limited awareness of the current state of knowledge about animal cognition and sentience in different species and a detached, unempathic approach towards animals may have negative implications for vets' capacity to ensure animal welfare and concern about patients' well-being (Paul & Podberscek 2000). Indeed, a study by Ellingsen *et al* (2010) showed that empathy was the best predictor of how people rated pain in dogs and another study by Norring and colleagues (2014) revealed that empathic vets score cattle pain higher, with important consequences for the welfare of these animals.

Although some studies have focused on empathy towards animals in veterinary students, to our knowledge all of them have been carried out at British, Australian and North American universities, whereas research on veterinary students in Italian universities is completely lacking.

The main aim of the current study was to start exploring the Italian scenario of veterinary medicine, testing a sample of veterinary students to assess whether and to what extent veterinary education influenced empathy towards animals, anthropomorphism and beliefs in animal mind and sentience (namely perception of continuity between humans and other animals), as observed in other countries. The second aim was to evaluate whether gender differences emerged in undergraduate Italian veterinary students as clearly as in other countries and samples. To reach these goals we employed two validated scales, already used in the literature: the Animal Empathy Scale (AES) developed by Paul (2000) and the Human-Animal Continuity Scale (HACS) constructed and validated by Templer *et al* (2006). To evaluate the effect of the scientific training, we compared students of the first and fifth year of the veterinary course. Finally, we set out to investigate the relationship between empathy and continuity beliefs to see whether these concepts may be related.

Based on previous literature suggesting a decrease in empathy and reduced belief in animal mind and sentience over time (Shurtleff *et al* 1983; Hellyer *et al* 1999; Paul & Podberscek 2000) and showing gender is a relevant variable in the level of empathy towards animals (eg Paul & Podberscek 2000; Ellingsen *et al* 2010), we predicted that first-year students would show a higher level of reported empathy towards animals and a greater perception of continuity between humans and non-human animals than those of the fifth year; we also hypothesised that females would obtain higher scores compared to males.

Materials and methods

Participants

The initial sample comprised 131 first-year (34 males, 97 females) and 158 fifth-year (44 males, 114 females) students of veterinary medicine at the University of Milan, Italy. All students were informed of the study during class time and their participation was voluntary and anonymous.

Fifteen participants (six first year: three females and three males and nine fifth year: five females and four males) did not complete the HACS and two participants (one first-year male and one fifth-year male) did not complete the AES and were thus excluded from the correspondent analyses. Hence, the final sample consisted of 125 first-year students (31 males and 94 females ranging from 18 to 38 years of age: mean (\pm SD) = 20.2 (\pm 2.1) and 149 fifth-year students (40 males and 109 females ranging from 22 to 47 years of age: 25.1 [\pm 3.4]) for the HACS, and of 130 first-year students (33 males, 97 females) and 157 fifth-year students (43 males, 114 females) for the AES.

Procedure

Participants were asked to complete the questionnaire 20 min prior to the start of a lecture and to return it to a researcher, who was present in the room to answer to any potential questions regarding the subject matter.

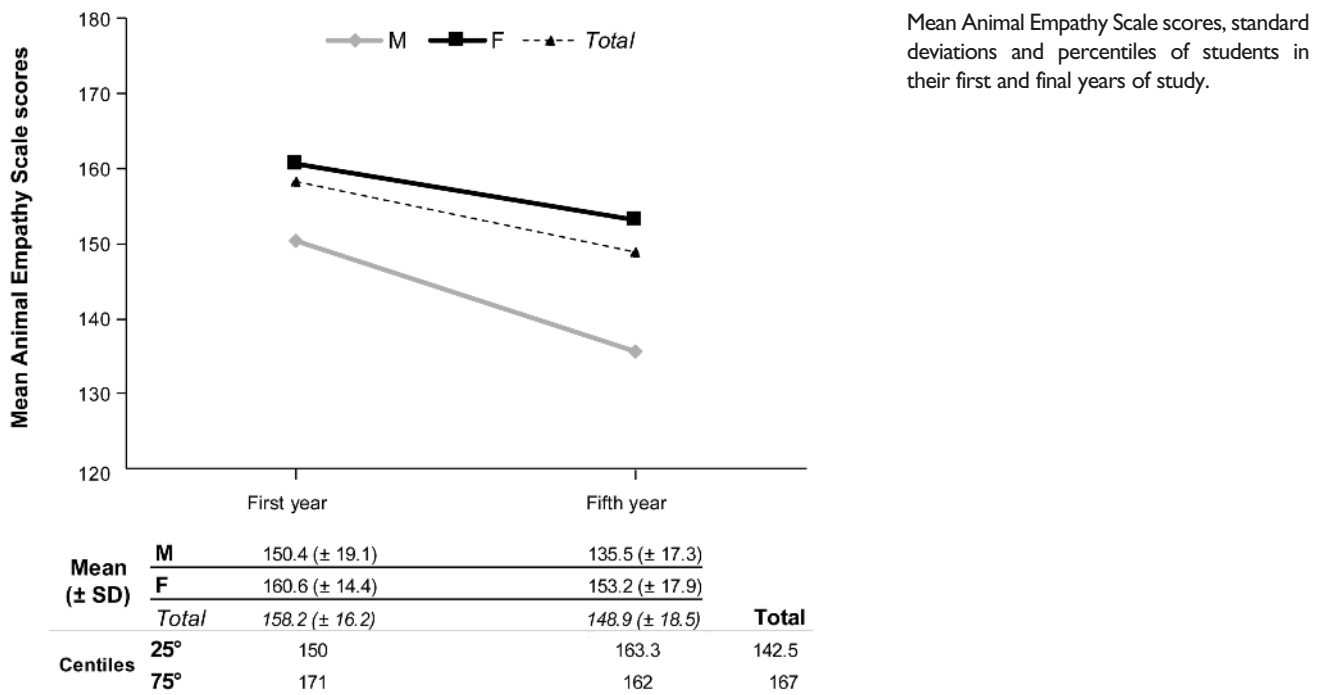
Students were told that the purpose of the survey was to gain knowledge regarding the human-animal relationship and that their responses would remain anonymous and be used for scientific research only. We did not mention explicitly that the questionnaire was aimed at assessing empathy and perception of human-animal continuity, in order to avoid a social desirability effect on students' responses; for the same reason, students were told that there were no right or wrong answers as we were interested in knowing their authentic point of view. After completing the questionnaire, they were fully debriefed about the real purpose of the study and they read and signed an informed consent form and an authorisation to allow us to use the data.

Questionnaire

The whole questionnaire consisted of three parts. Part 1 aimed at obtaining information on students' age, gender and background experience (eg previous and present interaction/experiences with animals, past or actual pet ownership, religion, eating habits [vegetarian or not]) which could be relevant in affecting their responses. Part 2 comprised the Animal Empathy Scale (AES), designed to measure empathy towards animals (Paul 2000). This scale includes a total of 22 items, eleven representing unempathic sentiments and eleven empathic sentiments. The majority of items emphasise negative events and emotions. Responses to each item are requested using a nine-point Likert-type scale, ranging from 'Agree very strongly' to 'Disagree very strongly', with agreements with empathic statements scoring high (maximum 9) and agreements with unempathic statements scoring low (minimum 1). The total Animal Empathy Scale score is calculated as the sum of the 22 responses: thus, total score can range from a minimum of 22 to a maximum of 198, with higher scores indicating stronger levels of self-reported empathy (Paul 2000).

Part 3 comprised the Human-Animal Continuity Scale, constructed and validated by Templer *et al* (2006) to measure the extent to which humans and animals are viewed on the same continuum or in a dichotomous way. The scale includes a total of 12 items regarding the perception of continuity between humans and animals and responses to each item are requested using a 7-point Likert-type scale, ranging from 'strongly disagree' (1) to 'strongly agree' (7). Some items represent anthropomorphic considerations about animals (eg item 8: 'animals can fall in love'), others are related to the perception of similarity between humans and animals (eg item 4 'people are animals') and some measure to what extent people believe in animal sentience and cognition (eg item 2, 'Humans can think but animals cannot'). The authors reported that factor analysis yielded three factors that were labelled 'rational capacity', 'superiority vs equality' and 'evolutionary continuum'.

Figure 1



Hence, the scale content seemed to cover three important components of our relationship with animals, namely anthropomorphism, belief in animal mind and sentience and perception of similarity.

Total scores on the Human-Animal Continuity Scale (HACS) potentially range from 12 to 84, with higher scores indicating higher levels of self-reported perception of human-animal continuity.

Both scales had been previously validated and were specially translated into Italian (with back-translation) for this study. The AES and HACS scales were administered in a counter-balanced order.

Statistical analysis

Total scores on the AES and HACS scales were calculated. The internal consistency of both scales was assessed using Cronbach's alpha and, if unsatisfying, an exploratory factorial analysis was run in order to evaluate the scale dimensionality. Two-way analysis of covariance (ANCOVAs) were performed to evaluate the effect of gender, year of course and age on total score (AES) and on single-items' scores (HACS); subsequent simple effects analysis (one-way ANOVAs) verified the effects of one variable at individual levels of the other independent variable. Pearson correlation coefficient was used to assess the relationship between AES global score and HACS specific items.

All the statistical analyses were carried out with SPSS Statistics 21 (IBM, NY, USA), except for the latent structure coefficients, evaluated with the R package 'sem' (Fox *et al* 2014).

Results

Twelve participants among those who completed the questionnaire were excluded from the dataset because their AES score exceeded (± 2) SD from the mean (first year: two males; fifth year: four females and six males); the remaining 261 students (76.2% females) were evaluated in subsequent analyses. Almost all subjects were neither vegetarian nor vegan (89.3%) and owned a pet at the moment the study (88.1%) or had owned a pet in the past (90%). Most participants declared themselves to be either atheist/agnostic (39.8%) or Catholic (48.4%) with other religions being extremely rare (0.09%). As participants who declared themselves to be Catholic did not specify if they were practicing or not, we decided to exclude religion from the analyses.

AES

The Cronbach alpha coefficient showed a good reliability for AES (alpha = 0.834), higher than that reported by Paul (2000; alpha = 0.78). AES total score distribution was analogous to the normal curve (asymmetry = -0.38 , SE = 15; kurtosis = -0.29 , SE = 0.30; Kolmogorov-Smirnov test: $P > 0.05$) and thus we used parametric statistical tests. Descriptive statistics of the sample (mean scores, standard deviations and percentiles) are reported in Figure 1.

A two-way ANCOVA (gender \times year of course; covariate: age) revealed a weak effect of age on empathy ($F_{1,257} = 5.96$; $P < 0.05$, partial eta-squared = 0.02) and stronger, significant main effects of gender ($F_{1,257} = 32.1$; $P < 0.01$, partial eta-squared = 0.11) and year of course ($F_{1,257} = 20.5$; $P < 0.01$, partial eta-squared = 0.07), but not an interaction between

Table 1 Gender and year differences in scores in single items of the Animal Empathy Scale related to the owner-pet bond and to pet distress (standard deviations reported in brackets).

		Gender			Year of course		
		Males	Females	$F_{1,259}$, P -value; η^2 par	First	Fifth	$F_{1,259}$, P -value; η^2 par
AES-sensitivity toward owner-pet bond	AES 8	7.0 (\pm 2.3)	7.8 (\pm 2.1)	6.1, $P < 0.05$; 0.02	8.1 (\pm 1.8)	7.4 (\pm 2.4)	13.03, $P < 0.01$; 0.05
	AES 12	4.8 (\pm 2.7)	5.9 (\pm 2.9)	6.65, $P < 0.01$; 0.03	6.1 (\pm 2.9)	5.2 (\pm 2.9)	5.93, $P < 0.05$; 0.02
	AES 14	7.5 (\pm 2.0)	8.5 (\pm 1.2)	20.9, $P < 0.01$; 0.08			
	AES 16	6.5 (\pm 2.5)	7.4 (\pm 2.4)	6.81, $P < 0.01$; 0.03			
	AES 19	6.7 (\pm 2.2)	7.5 (\pm 2.1)	6.17, $P < 0.05$; 0.02	7.8 (\pm 1.9)	6.9 (\pm 2.3)	8.7, $P < 0.01$; 0.03
AES-sensitivity to pets' distress signals	AES 2				5.5 (\pm 2.5)	4.4 (\pm 2.8)	11.25, $P < 0.01$; 0.04
	AES 4	6.2 (\pm 2.6)	7.3 (\pm 2.2)	10.61, $P < 0.01$; 0.04	7.6 (\pm 2.1)	6.6 (\pm 2.5)	13.27, $P < 0.01$; 0.05
	AES 11				6.5 (\pm 2.5)	5.8 (\pm 2.5)	5.12, $P < 0.05$; 0.02

these two factors. The subsequent simple effects analysis explored the effect of gender at the individual levels of year of course, and vice versa. Males were slightly less empathic than females (one-way ANOVA, $F_{1,119} = 9.07$; $P < 0.01$, partial eta-squared = 0.07) since the first year of course; this difference was maintained and only slightly increased up to the fifth year ($F_{1,138} = 25.37$; $P < 0.01$, partial eta-squared = 0.15): in fifth year, both males and females showed a lower AES score (females: $F_{1,197} = 9.9$; $P < 0.01$, partial eta-squared = 0.05; males: $F_{1,60} = 10.4$; $P < 0.01$, partial eta-squared = 0.13; Figure 1). Age was positively but weakly related only to the fifth-year students' empathy ($b = 0.96$, 95% CI: 0.04–1.89).

A number of items of particular interest for veterinary practice were selected and further analysed: five of them concerned the sensitivity to the owner-pet bond (items 8, 12, 14, 16, 19) and four were related to sensitivity to pets' (dogs and cats) distress signals (items 2, 4, 11).

A two-way ANOVA (gender \times year of course) showed a main effect of gender: male students were less empathic on all the items concerning the sensitivity toward the owner-pet bond and on item 4 ["I get annoyed by dogs that howl and bark when they are left alone"] related to pets' distress. Moreover, there was an effect of the year of course, with fifth-year students being less empathic than first-year students on items 8, 12 and 19 ("People who cuddle and kiss their pets in public annoy me", "Many people are over-affectionate towards their pets", "People often make too much of the feelings and sensitivities of animals") and on items 2, 4, 11 ("Often cats will meow and pester for food even when they are not really hungry", "I get annoyed by dogs that howl and bark when they are left alone", "Dogs sometimes whine and whimper for no real reason") (see Table 1).

HACS

With regard to the Human Animal Continuity Scale, we found an unsatisfactory internal consistency (Cronbach's alpha = 0.51), also confirmed by its factors loading matrix (Principal Components Analysis, orthogonal Varimax rotation, Kaiser's eigenvalues-greater-than-one rule; see Table 2), whose five factors, overall accounting only for 61% of variance, were formed by only one or two items, not semantically bounded (except for Factor 1, whose loadings were with items 7, 6, 11). Coherently, all factors presented insufficient internal consistency coefficients, ranging from alpha = 0.57 (Factor 2) to alpha = 0.29 (Factor 1), and the overall factorial matrix showed a poor goodness of fit: Goodness of Fit Index GFI = 0.787 (GFIs are acceptable when > 0.9 see, eg Jöreskog & Sörbom 1984), Root Mean Squared Error of Approximation RMSEA = 0.256 (RMSEA are optimal when < 0.05 , acceptable when < 0.08 or < 0.1 see, eg Steiger & Lind 1980). This result contrasts with that reported by Templer *et al* (2006), who constructed and validated this scale finding a quite acceptable internal consistency (Cronbach's alpha = 0.69) and identifying three distinct factors.

Given the low internal consistency, we decided to focus on single items rather than on a global score. We focused on items that appeared suitable to assess two important aspects which may be affected by veterinary education: cognitive and phylogenetic continuity between humans and animals (ie item 2: "Humans can think but animals cannot", item 4: "People are animals" and item 6: "People evolved from lower animals"), and instrumental attitude toward animals (ie item 10: "The needs of people should always come before the needs of animals"; item 11: "It's okay to use animals to carry out tasks for humans"; item 12: "It's crazy to think of an animal as a member of your family"). All these items respected the normal distribution characteristics (asymmetry and kurtosis less or equal to 1

Table 2 The Human-Animal Continuity Scale rotated components pattern.

Items	Component				
	1	2	3	4	5
7. People are superior to animals	0.702	0.315			
6. People evolved from lower animals	-0.671				
11. It's ok to use animals to carry out tasks for human	0.653				
10. The needs of people should always come before the needs of animals	0.629				
2. Human can think but animals cannot		0.857			
1. Humans have a soul but animals do not		0.734	0.368		
3. People have a life after death but animals do not		0.325	0.741		
9. People have a spiritual nature but animals do not			0.726		
4. People are animals				0.746	
5. Animals are afraid of death				0.706	
12. It's crazy to think of an animals as member of your family					0.832
8. Animals can fall in love				0.486	0.586

Only loadings ≥ 0.300 are shown.

Table 3 Gender and year differences in the Human-Animal Continuity Scale items on instrumental attitude toward animals (standard deviations are reported in brackets).

	Gender			Year of course			
	Males	Females	$F_{1,246}$, P -value; η^2 par	First	Fifth	$F_{1,246}$, P -value; η^2 par	
HACS-instrumental	HACS 10	3.6 (\pm 0.2)	2.63 (\pm 0.1)	22.48, $P < 0.01$; 0.07	2.1 (\pm 0.2)	3.55 (\pm 0.2)	13.19, $P < 0.01$; 0.05
	HACS 11				3.93 (\pm 0.2)	4.84 (\pm 0.2)	13.98, $P < 0.01$; 0.05
	HACS 12	1.8 (\pm 0.1)	1.2 (\pm 0.1)	13.74, $P < 0.01$; 0.05	1.37 (\pm 0.2)	1.69 (\pm 0.1)	4.71, $P < 0.05$; 0.02

and not significant; Shapiro normality test), except for item 2 and item 12, whose lower tails were fairly under-represented (kurtosis_{item2} = 8.5; kurtosis_{item12} = 9.9; Shapiro test, P -values < 0.01). However, as in our opinion the content of these two items was relevant to the topics of the study and, in particular, to the veterinary profession, we decided to consider them.

A two-way ANCOVA (gender \times year of course; covariate: age) confirmed a non-significant effect of age, for all the items considered. Scores on items related to the perception of phylogenetic and cognitive continuity revealed a weak and almost significant difference, depending on the main effect of the course year, for only item 4 ("People are animals": $F_{1,257} = 3.4$; $P = 0.07$, partial eta-squared = 0.01): fifth-year students scored lower than those in the first year. There was a significant main effect of gender ($F_{1,257} = 6.7$; $P < 0.05$, partial eta-squared = 0.02) and a gender per year effect ($F_{1,257} = 5.91$; $P < 0.05$, partial eta-squared = 0.02) on item 2 ("Humans can think but animals cannot"): the

discrepancy between first- and fifth-year students' scores was greater among males. In contrast, scores on items related to an instrumental attitude toward animals (Table 3) were higher in fifth-year students (items 10, 11 and 12) and in males (items 10 and 12).

Relationship between empathy and perception of human-animal continuity

There were significant, moderate negative correlations (Pearson's r coefficients) between AES total score and scores on HACS items related to instrumental attitude toward animals ($r_{T-10} = -0.419$; $P < 0.01$; $r_{T-11} = -0.396$; $P < 0.01$; $r_{T-12} = -0.333$; $P < 0.01$).

Discussion

The aim of the current study was to investigate the relationship between empathy toward animals, perception of human-animal continuity and veterinary education in a sample of Italian veterinary students.

Overall, our results are in agreement with those of previous studies carried out in other countries, which show that veterinary students' attitudes towards animals in terms of empathy, beliefs in animal sentience and beliefs in animal cognitive abilities seem to worsen during the veterinary education process, giving rise to a more instrumental attitude toward them and a more Cartesian perspective on their psychology. In addition, current findings confirm previous evidence that gender influences the level of empathy towards animals and attitudes towards them (Paul & Podberscek 2000; Taylor & Signal 2005; Signal & Taylor 2007; Ellingsen *et al* 2010).

In their UK cross-sectional study on veterinary students' attitudes towards the welfare of animals, Paul and Podberscek (2000) found that the year of study was significantly related to the perceived sentience of domestic animals (dogs, cats and cows), with students in their later years of study attributing lower levels of sentience; moreover, female students rated themselves as having significantly higher levels of emotional empathy with animals than did male students, and maintained relatively high levels of empathy over time, whereas male students showed decreasing levels of empathy through years.

The current study based on the AES scale revealed a significant difference in self-reported empathy towards animals between the first and the final year of the veterinary curriculum in both male and female students, which might suggest an effect of education. Male students always scored as less empathic than females, independently of the year of study, and such an effect was stronger than that due to the year of course.

The presence of gender differences in empathy scores is consistent with the psychological literature, which demonstrates that, in general, females tend to be more empathic than males towards both human and non-human beings (Davis 1980; Paul & Podberscek 2000; Baron-Cohen & Wheelwright 2004; Signal & Taylor 2007; Ellingsen *et al* 2010), and show greater concern for their welfare and suffering than males (Heath & Lanyon 1996; Capner *et al* 1999; Serpell 2005; Hazel *et al* 2011). Interestingly, similar findings have been reported in human medicine with regards to empathy towards patients in both students and professionals (Hojat *et al* 2002; Austin *et al* 2007; Berg *et al* 2011). In particular, it has been shown that females score higher than males on measures of emotional reactivity (empathic concern and personal distress), while cognitive abilities, such as perspective-taking and recognition of affect in others, reveal no consistent sex differences (Davis 1980). These findings, however, are consistent only with older children/adolescents and adults (Schulte-Rüther *et al* 2008; Bandstra *et al* 2011; Roth-Hanania *et al* 2011), and this may suggest the internalisation of social expectation regarding gender role and gender identity, through social learning processes (Roth-Hanania *et al* 2011).

Yet, a genetic effect cannot be excluded since it has been postulated that, during phylogeny, empathy might have evolved within the context of parental care, in order to facilitate the mother-offspring bond (Preston & de Waal 2002). Recently,

Derntl and colleagues (2013) showed an effect of female reproductive hormones on empathy, suggesting the role of progesterone in predisposing women to empathic behaviour.

Like Paul and Podberscek's work (2000), our study was not a longitudinal one, so we cannot conclude that the difference in empathy we found towards animals necessarily represents a real decline due to an effect of education. However, our findings are in line with the hypothesis that students' empathy and attitudes towards animals could be impaired by veterinary education, as already reported for empathy towards people in human medicine (Austin *et al* 2007; Hojat *et al* 2009; Neumann *et al* 2011; Nunes *et al* 2011). The effect of education on empathy could be confused with the effect of age, however, our results indicate that the effect of age on empathy was very limited and, when partialised, the effect of education remained significant. As the selection test to enter the veterinary school, the curriculum and the teaching staff were consistent for the two cohorts of students and the questionnaire was administered during compulsory attendance lectures (and almost all students participated in the study), it is reasonable to assume that both cohorts of students were comparable.

The potential effect of education on students' empathy is an interesting finding and, given the importance of empathy for animal welfare, more studies and, in particular, longitudinal studies, would be necessary to confirm it and gain a better understanding of the aspects of the Italian veterinary education that are responsible for this apparent decrease in empathy.

Paul and Podberscek (2000), reviewed possible reasons for veterinary students' decline in empathy and belief in animal mind and sentience, suggesting that this could either be a way of coping with the moral conflict and emotional distress which older students are expected to encounter in veterinary work, or the result of a role-modelling process, similarly to what happens to medical students (Paice *et al* 2002; Burks & Kobus 2012). As the authors noticed, younger veterinary students were traditionally exposed to and emulated a masculine role model, whose behavior and attitudes towards animals were characterised by tough-mindedness, devaluing emotional concern.

More recently, Levine *et al* (2005) suggested that differences in students' perception of companion-animal and farm-animal emotional and cognitive abilities that emerged in their study could also depend on a lack of awareness of the current state of scientific knowledge about cognitive and emotional abilities of domestic species; they also suggested that it would be useful to educate veterinary students formally and specifically on animal cognition, in order to guarantee the application and maintenance of high standards of animal welfare in practice. The current study, being the first carried out in Italy, does not allow us to disentangle the possible reasons for the observed apparent decrease in empathy, but it would be interesting to address this aspect in more detail in future studies.

Although the difference in empathy towards animals that emerged between first- and final-year veterinary students

could, in principle, be a source of worry, it is worth considering that in this study the mean empathy score of both males and females in the first and final year was relatively high, thus indicating an overall satisfactory level of empathy. Moreover, as 76.2% of the participants were females, and this preponderance of female students reflects a clear trend with a growing number of women undertaking veterinary medicine (Hart & Melese d'Hospital 1989), a more feminine and empathic attitude towards animals is likely to develop in Italy in the future.

Unfortunately, we could not directly compare our students' scores with those reported by Paul and Podberscek (2000), since they used a 28-item version of the AES, or with those from the study by Ellingsen *et al* (2010), since they adopted a seven-point Likert scale.

The only data available for comparisons are those by Paul (2000) and by Meyer *et al* (2014), which are relative to a general sample of Scottish adults and to a sample of second-year Swedish veterinary students (mainly females), respectively. Interestingly, our first-year students' scores appear to be slightly higher than those of Scottish pet-owners, whereas fifth-year male, but not female, students' scores resemble more those of the non-pet owners. Moreover, our sample empathy scores seem higher than those reported by Meyer *et al* (2014), for second-year Swedish veterinary students.

In general, studies using the AES have considered only the total score (eg Paul 2000; Paul & Podberscek 2000; Taylor *et al* 2004; Ellingsen *et al* 2010), whereas we decided to focus also on single items that could be particularly relevant for veterinary practice, namely those related to the sensitivity towards the owner-pet bond and sensitivity towards pets' distress signals. In fact, in Italy, even if the veterinary core curriculum is common to all students and more related to farm animals and production, many students end up treating pets.

For both these aspects (sensitivity to owner-pet bond and to pets' distress signals), the general trend of empathy was confirmed: there was an effect of year of course, with final-year students reporting lower levels of empathy, and a clear effect of gender, especially for items related to sensitivity to owner-pet bond, with females more sensitive than males. These results are of some concern as the human-animal bond is considered an important motivation for people to seek veterinary care for their pets and the veterinarians' sensitivity toward the owner-pet bond is recognised as a determinant of a successful private practice (Mitchner & Ogilvie 2002).

For these reasons, some changes in veterinary medical education have been suggested, such as training veterinary students to deal with the human-animal bond (Adams *et al* 2004) and in animal behaviour in order to improve the vet-owner-pet relationship, animal handling, and managing of animals' pain and distress (Sherman & Serpell 2008; Rodan *et al* 2011; Carney *et al* 2012).

A lower sensitivity toward animals' distress in veterinary students in their final year was also found in previous studies (Hellyer *et al* 1999; Paul & Podberscek 2000) and may be due to a habituation process, as suggested by Pillai Riddell and Craig (2007), who found that paediatricians

attributed significantly lower levels of pain to infants' facial expressions than did parents. As these authors noticed, health professionals may become slightly habituated to patients' pain signs because of their extended exposure to them. It would be interesting to evaluate this effect in veterinary students using visual or auditory material, such as photographs or videos of animals in pain or distress.

A further interesting finding is that the AES scale devised by Paul (2000) and used in other studies was confirmed as having good psychometrical characteristics, including high internal consistency and little evidence of cultural bias. This allows us to provide a normative standard for Italian veterinary students and opens the way for a more systematic study of empathy towards animals in other samples (eg veterinary students from different Italian universities, veterinary professionals, stockpersons, scientists, etc) who, in different ways, work in areas related to animal welfare and care.

As regards the Human Animal Continuity Scale, in the current study it revealed low internal consistency and an unsatisfactory factorial structure. This scale was originally constructed by Templer *et al* (2006) with the interesting goal of measuring the extent to which people view humans and animals on the same continuum; the authors suggested the suitability of the scale in human-animal relationship research, so we used it to evaluate if and how perception of continuity between humans and other animals varied during veterinary education (ie with increasing practice and knowledge about animals), and whether a higher perception of continuity would be associated with a higher level of empathy towards animals.

The low internal consistency of the HACCS scale revealed in this study suggests that this scale may not be readily employable with populations and aims that differ from those of the original study. However, to our knowledge this is the only study that used this scale since its original construction and validation; thus, more work seems necessary before a final conclusion on its content validity and construct validity can be drawn. As underlined by Templer *et al* (2006), the issue of people's beliefs in human-animal continuity is extremely interesting and warrants further investigation.

In particular, it is reasonable to hypothesise a relationship between beliefs in human-animal continuity and the tendency to empathise with them (Westbury & Neumann 2008; Apostol *et al* 2013; Prguda & Neumann 2014). A reliable measure of whether and to what extent people consider humans and other animals on a continuum could provide insight into the different variables shaping people's beliefs in animal-human continuity; it could also provide interesting information as to the extent to which the growing scientific knowledge on animals' cognitive abilities coming from disciplines, such as ethology, comparative psychology and neuroscience is spread among non-experts, and how it might help in promoting different aspects of animal welfare. As Levine *et al* (2005) suggested, given the key role of veterinarians in promoting animal welfare, it would be important to educate veterinary

students on animal cognition and comparative cognition, to make them aware of the psychological processes that take place in the species they will take care of. Moreover, Hazel and colleagues (2011) demonstrated that veterinary students' attitudes towards animals became more positive after an animal-welfare course.

Although total scores could not be used, some interesting results emerged from the analysis of the HACS items concerning instrumental attitudes toward animals and perception of phylogenetic and cognitive continuity.

Regarding instrumental attitudes, similarly to what emerged for empathy scores, for all items we found a significant effect of the year of course, with first-year students having a lower instrumental attitude than their final-year colleagues; there was also an effect of gender, with females being more prone to view an animal as a member of the family and less prone to take an instrumental attitude. It's worth noting that only for item 11 "It's ok to use animals to carry out tasks for humans" first-year students reported a slight disagreement and fifth-year students a slight agreement, while for the other two items scores reflected a disagreement with the statements in both groups, suggesting that veterinary students in our sample had an overall positive attitude towards animals.

Results on perception of continuity between animals and humans (ie "Human can think but animals cannot", "People are animals" and "People evolved from lower animals") were more variable and the effect of year of course and gender less evident: an effect of gender and a gender-per-year was found only for the item "humans can think but animals cannot", with females being more prone to attribute the capacity of thinking to animals and a more marked difference between first- and fifth-year male students, supporting the results obtained by Paul and Podberscek (2000). However, students' scores remained within the positive range, revealing a good perception of phylogenetic and cognitive continuity between humans and animals.

Finally, we found a significant negative correlation between the empathy global score and scores related to instrumental attitudes toward animals, which supports the existence of a relationship between these two aspects. This result confirms the need to pay attention in planning academic veterinary curricula, for instance combining courses concerning animal production with those related to animal cognition and welfare, in order to avoid the development of an instrumental attitude towards animals (Levine *et al* 2005; Main 2010; Hazel *et al* 2011). In fact, empathy and attitudes toward animals have been influenced by the introduction of zootechnology and the industrialisation of animal farming, which is based on industrial and intensified systems. These two phenomena, which have tended to promote a more mechanistic view of animals (Porcher 2006, 2011), may interfere with veterinary students' abilities to advocate for the welfare of the animals in their care by suppressing empathy (Martinsen 2007).

Future research

In summary, the current study is a first step in the exploration of the Italian scenario as regards empathy in veterinary medicine. The emerging scenario appears to be in tune with evidence accumulated so far in other countries, although further studies are needed before a more general conclusion on the relationships between empathy toward animals, perception of human-animal continuity, and veterinary education can be drawn. This study, as most of those carried out so far (eg Shurtleff *et al* 1983; Hellyer *et al* 1999; Paul & Podberscek 2000) was based on a cross-sectional design, therefore it would be necessary to carry out longitudinal studies to assess whether the noted differences in empathy and attitudes towards animals are actually due to veterinary education. These kinds of studies are still very limited in the veterinary field (eg Heath *et al* 1996; Heath & Lanyon 1996) and, to our knowledge, none has focused on topics such as empathy towards animals or belief in animal mind.

It would be important also to integrate self-assessment with other, more objective measures of empathy, such as behavioural or physiological indices, to overcome the limitations of self-rating. Moreover, it would be intriguing to assess whether and to what extent the apparent decrease in empathy exhibited by students represents a coping strategy, depends on role-modelling or is attributable to an inadequate efficacy, or even the unwillingness, of universities to teach animal welfare, animal behaviour and psychology and animal ethics in veterinary courses (Arluke 2004; Martinsen 2007). It would also be relevant to evaluate whether the apparent changes in empathy occurring during veterinary education represent the first symptom of a trend which continues throughout veterinary practice.

Finally, cross-cultural studies employing the same methodology are needed to compare empathy levels and attitudes towards animals in veterinary students from different countries, in order to better understand the effect of gender and curricula; for example, in Italy, animal experiments in veterinary education are not allowed, unlike in other countries (eg Arluke 2004; Martinsen 2007), and this kind of didactic method may have a strong impact on students' empathy and attitudes (Arluke & Hafferty 1996; Birke & Arluke 2007; Daly and Morton 2008).

Animal welfare implications and conclusion

In line with previous studies, our results revealed an apparent decline in empathy towards animals during the veterinary academic training, with first-year students scoring significantly higher than those in their final year. Moreover, perception of continuity between humans and animals was different between the first and final year of course, and students at the end of their university education reported a more instrumental attitude toward animals. This effect may be due to a process of role-modelling, to a strategy of affective control to cope with personal distress in

response to animals' suffering and to the structure of academic curriculum, which is especially concerned with animal production. In order to avoid the development of a marked instrumental attitude toward animals in veterinary students, it could be useful to endorse courses about animal welfare, animal cognition, ethology and the human-animal bond in veterinary education.

Finally, we found a gender effect on empathy toward animals and on perception of continuity between humans and animals, with females always obtaining higher scores than males. As nowadays the majority of veterinary students are female, a more empathic attitude towards animals may develop in Italian veterinary medicine in the future.

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References

- Adams CL, Conlon PD and Long KC** 2004 Professional and veterinary competencies: addressing human relations and the human-animal bond in veterinary medicine. *Journal of Veterinary Medical Education* 31(1): 67-72. <http://dx.doi.org/10.3138/jvme.31.1.67>
- Al-Fayez G, Awadalla A, Templer DI and Arikawa H** 2003 Companion animal attitude and its family pattern in Kuwait. *Society & Animals* 11(1): 17-28. <http://dx.doi.org/10.1163/156853003321618819>
- Apostol L, Rebege OL and Miclea M** 2013 Psychological and socio-demographic predictors of attitudes toward animals. *Procedia: Social and Behavioral Sciences* 78: 521-525. <http://dx.doi.org/10.1016/j.sbspro.2013.04.343>
- Arluke A** 2004 The use of dog in medical and veterinary training: understanding and approaching student uneasiness. *Journal of Applied Animal Welfare Sciences* 7(3): 197-204. http://dx.doi.org/10.1207/s15327604jaws0703_6
- Arluke A and Hafferty F** 1996 From apprehension to fascination with 'dog lab': the use of absolutions by medical students. *Journal of Contemporary Ethnography* 25(2): 201-225. <http://dx.doi.org/10.1177/089124196025002002>
- Austin EJ, Evans P, Magnus B and O'Hanlon K** 2007 A preliminary study of empathy, emotional intelligence and examination performance in MBChB students. *Medical Education* 41: 684-689. <http://dx.doi.org/10.1111/j.1365-2923.2007.02795.x>
- Bandstra NF, Chambers CT, McGrath PJ and Moore C** 2011 The behavioural expression of empathy to others' pain versus others' sadness in young children. *Pain* 152: 1074-1082. <http://dx.doi.org/10.1016/j.pain.2011.01.024>
- Baron-Cohen S and Wheelwright S** 2004 The Empathy Quotient: an investigation of adults with Asperger Syndrome or High Functioning Autism, and normal sex difference. *Journal of Autism and Developmental Disorders* 34(2): 163-175. <http://dx.doi.org/10.1023/B:JADD.0000022607.19833.00>
- Berg K, Majdan JF, Berg D, Veloski J and Hojat M** 2011 Medical students' self-reported empathy and simulated patients' assessments of student empathy: an analysis by gender and ethnicity. *Academic Medicine* 86(8): 984-988. <http://dx.doi.org/10.1097/ACM.0b013e3182224f1f>
- Birke LI and Arluke A** 2007 *The Sacrifice: How Scientific Experiments Transform Animals and People*. Purdue University Press: West Lafayette, USA
- Burks DJ and Kobus AM** 2012 The legacy of altruism in health care: the promotion of empathy, prosociality and humanism. *Medical Education* 46: 317-325. <http://dx.doi.org/10.1111/j.1365-2923.2011.04159.x>
- Butterfield ME, Hill SE and Lord CG** 2012 Mangy mutt or furry friend? Anthropomorphism promotes animal welfare. *Journal of Experimental Social Psychology* 48(4): 957-960. <http://dx.doi.org/10.1016/j.jesp.2012.02.010>
- Capner CA, Lascelles BDX and Waterman-Pearson AE** 1999 Current British veterinary attitudes to perioperative analgesia for dogs. *Veterinary Record* 145(4): 95-99. <http://dx.doi.org/10.1136/vr.145.4.95>
- Carney HC, Little S, Brownlee-Tomasso D, Harvey AM, Mattox E, Robertson S, Rucinsky R and Manley DS** 2012 AAFP and ISFM feline-friendly nursing care guidelines. *Journal of Feline Medicine and Surgery* 14: 337-349. <http://dx.doi.org/10.1177/1098612X12445002>
- Daly B and Morton LL** 2008 Empathic correlates of witnessing the inhumane killing of an animal: an investigation of single and multiple exposures. *Society and Animals* 16: 243-255. <http://dx.doi.org/10.1163/156853008X323394>
- Davis MH** 1980 A multidimensional approach to individual differences in empathy. *Journal of the Siena Academy of Science: Catalogue of Selected Documents in Psychology* 10: 85-104
- Decety J and Lamm C** 2011 Empathy versus personal distress: recent evidence from social neuroscience. In: Decety J and Ickes W (eds) *The Social Neuroscience of Empathy* pp 199-213. MIT Press: Cambridge, USA
- Derntl B, Hack RL, Kryspin-Exner I and Habel U** 2013 Association of menstrual cycle phase to the core components of empathy. *Hormones and Behaviour* 63: 97-104. <http://dx.doi.org/10.1016/j.yhbeh.2012.10.009>
- de Waal FBM** 2008 Putting the altruism back into altruism: the evolution of empathy. *Annual Review of Psychology* 59: 279-300. <http://dx.doi.org/10.1146/annurev.psych.59.103006.093625>
- Drwecki BB, Moore CF, Ward SE and Prkachin KM** 2011 Reducing racial disparities in pain treatment: the role of empathy and perspective taking. *Pain* 152: 1001-1006. <http://dx.doi.org/10.1016/j.pain.2010.12.005>
- Dziobek I, Rogers K, Fleck S, Bahnemann M, Heekeren HR, Wolf OT and Convit A** 2008 Dissociation of cognitive and emotional empathy in adults with Asperger Syndrome using the Multifaceted Empathy Test (MET). *Journal of Autism and Developmental Disorders* 38: 464-473. <http://dx.doi.org/10.1007/s10803-007-0486-x>
- Ellingsen K, Zanella AJ, Bjerkås E and Indrebo A** 2010 The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös* 23(3): 231-243. <http://dx.doi.org/10.2752/175303710X12750451258931>
- Filippi M, Riccitelli G, Falini A, Di Salle F, Vuilleumier P, Comi G and Rocca MA** 2010 The brain functional networks associated to human and animal suffering differ among omnivores, vegetarians and vegans. *Plos One* 5(5): e10847. <http://dx.doi.org/10.1371/journal.pone.0010847>

- Fischer ML and Tamioso PR** 2013 Perception and position of animals used in experimentation by students and teachers of different academic fields. *Estudos de Biologia* 35(84): 85-98. <http://dx.doi.org/10.7213/estud.biol.7846>
- Fox J, Nie Z and Byrnes J** 2014 SEM: *Structural Equation Models. R package version 3.1-5*. <http://CRAN.R-project.org/package=sem>
- Harrison MA and Hall AE** 2010 Anthropomorphism, empathy and perceived communicative ability vary with phylogenetic relatedness to humans. *Journal of Social, Evolutionary and Cultural Psychology* 4(1): 34-48. <http://dx.doi.org/10.1037/h0099303>
- Hart LA and Melese-d'Hospital P** 1989 The gender shift in the veterinary profession and attitudes toward animals: A survey and overview. *Journal of Veterinary Medical Education* 16: 27-30
- Hazel SJ, Signal T and Taylor S** 2011 Can teaching veterinary and animal-science students about animal welfare affect their attitude toward animals and human-related empathy? *Journal of Veterinary Medical Education* 38(1): 74-83. <http://dx.doi.org/10.3138/jvme.38.1.74>
- Heath TJ and Lanyon A** 1996 A longitudinal study of veterinary students and recent graduates: 4. Gender issues. *Australian Veterinary Journal* 74(4): 305-308. <http://dx.doi.org/10.1111/j.1751-0813.1996.tb13783.x>
- Heath TJ, Lynch-Blosse M and Lanyon A** 1996 A longitudinal study of veterinary students and recent graduates: 1. Backgrounds, plans and subsequent employment. *Australian Veterinary Journal* 74: 291-296. <http://dx.doi.org/10.1111/j.1751-0813.1996.tb13778.x>
- Hellyer PW, Casey F, Lacy M, Salman MD and Wagner AE** 1999 Attitudes of veterinary medical students house officers clinical faculty and staff toward pain management in animals. *Journal of American Veterinary Medical Association* 214: 238-244
- Hills AM** 1993 The motivational bases of attitudes toward animals. *Society & Animals* 1(2): 111-128. <http://dx.doi.org/10.1163/156853093X00028>
- Hills AM** 1995 Empathy and belief in the mental experience of animals. *Anthrozoös* 8: 132-142. <http://dx.doi.org/10.2752/089279395787156347>
- Hojat M, Gonnella JS, Nasca TJ, Mangione S, Vergare M and Magee M** 2002 Physician empathy: definition, components, measurement, and relationship to gender and specialty. *American Journal of Psychiatry* 159(9): 1563-1569. <http://dx.doi.org/10.1176/appi.ajp.159.9.1563>
- Hojat M, Vergare MJ, Maxwell K, Brainard G, Herrine SK, Isenberg GA, Veloski J and Gonnella JS** 2009 The devil is in the third year: a longitudinal study of erosion of empathy in medical school. *Academic Medicine* 84(9): 1182-1191. <http://dx.doi.org/10.1097/ACM.0b013e3181b17e55>
- Jöreskog KG and Sörbom D** 1984 LISREL VI Users Guide, Third Edition. Scientific Software: Moorsville, IN, USA
- Knafo A, Zahn-Waxler C, Van Hulle C and Robinson JL** 2008 The developmental origins of a disposition toward empathy: genetic and environmental contributions. *Emotion* 8(6): 737-752. <http://dx.doi.org/10.1037/a0014179>
- Knight S, Vrij A, Cherryman J and Nunkoosing K** 2004 Attitudes towards animals use and belief in animal mind. *Anthrozoös* 17(1): 43-62. <http://dx.doi.org/10.2752/089279304786991945>
- Levine ED, Mills DS and Houpt KA** 2005 Attitudes of veterinary students at one US college toward factors relating to farm animals welfare. *Journal of Veterinary Medical Education* 32(4): 481-490. <http://dx.doi.org/10.3138/jvme.32.4.481>
- Main DCJ** 2010 Evolution of animal-welfare education for veterinary students. *Journal of Veterinary Medical Education* 37(1): 30-35. <http://dx.doi.org/10.3138/jvme.37.1.30>
- Martinsen S** 2007 Training the animal doctor: caring as a clinical skill. *Alternatives to Animal Testing and Experimentation* 14 Special Issue: 269-272
- Meyer I, Forkman B and Paul ES** 2014 Factors affecting the human interpretation of dog behaviour. *Anthrozoös* 27(1): 127-140. <http://dx.doi.org/10.2752/175303714X13837396326576>
- Mitchner KL and Ogilvie GK** 2002 Understanding compassion fatigue: keys for the caring veterinary healthcare team. *Journal of the American Animal Hospital Association* 38: 307-310. <http://dx.doi.org/10.5326/0380307>
- Neumann M, Edelhäuser F, Tauschel D, Fischer MR, Wirtz M, Woopen C, Haramati A and Scheffer C** 2011 Empathy decline and its reasons: a systematic review of studies with medical students and residents. *Academic Medicine* 86(8): 996-1009. <http://dx.doi.org/10.1097/ACM.0b013e318221e615>
- Norring M, Wikman I, Hokkanen AH, Kujala MV and Hänninen L** 2014 Empathic veterinarians score cattle pain higher. *The Veterinary Journal* 200(1): 186-190. <http://dx.doi.org/10.1016/j.tvjl.2014.02.005>
- Nunes P, William S, Sa B and Stevenson K** 2011 A study of empathy decline in students from five health disciplines during their first year of training. *International Journal of Medical Education* 2: 12-17. <http://dx.doi.org/10.5116/ijme.4d47.ddb0>
- O'Farrell V** 1990 Students' stereotypes of owners and veterinary practitioners. *Veterinary Record* 127: 625
- Paice E, Heard S and Moss F** 2002 How important are role models in making good doctors? *British Medical Journal* 325 (7366): 707. <http://dx.doi.org/10.1136/bmj.325.7366.707>
- Paul ES** 2000 Empathy with animals and with humans: are they linked? *Anthrozoös* 13(4): 194-202. <http://dx.doi.org/10.2752/089279300786999699>
- Paul ES and Podberscek AL** 2000 Veterinary education and students' attitudes towards animal welfare. *The Veterinary Record* 146: 269-272. <http://dx.doi.org/10.1136/vr.146.10.269>
- Phillips CJC** 2014 Effects of field of study on university students' attitudes towards animal issues. *Animal Welfare* 23: 459-466. <http://dx.doi.org/10.7120/09627286.23.4.459>
- Phillips CJC, Izmirli S, Aldavood SJ, Alonso M, Choe BI, Hanlon A, Handziska A, Illman G, Keeling L, Kennedy M, Lee GH, Lund V, Mejdell C, Pelagic VR and Rehn T** 2012 Students' attitudes to animal welfare and rights in Europe and Asia. *Animal Welfare* 21(1): 87-100. <http://dx.doi.org/10.7120/096272812799129466>
- Pillai Riddell RR and Craig KD** 2007 Judgments of infant pain: the impact of caregiver identity and infant age. *Journal of Pediatric Psychology* 32(5): 501-511. <http://dx.doi.org/10.1093/jpepsy/psl049>
- Porcher J** 2006 Well-being and suffering in livestock farming: living conditions at work for people and animals. *Sociologie du Travail* 48: e56-e70. <http://dx.doi.org/10.1016/j.socotra.2006.02.001>
- Porcher J** 2011 The relationship between workers and animals in the pork industry: a shared suffering. *Journal of Agricultural and Environmental Ethics* 24: 3-17. <http://dx.doi.org/10.1007/s10806-010-9232-z>

- Preston SD and de Waal FBM** 2002 Empathy: its ultimate and proximate bases. *Behavioral and Brain Sciences* 25(1): 1-71
- Prguda E and Neumann DL** 2014 Inter-human and animal-directed empathy: A test for evolutionary biases in empathetic responding. *Behavioural Processes* 108: 80-86. <http://dx.doi.org/10.1016/j.beproc.2014.09.012>
- Rodan I, Sundahi E, Carney H, Gagnon A, Heath S, Landsberg G, Seksel K and Yin S** 2011 AAEP and ISFM feline-friendly handling guidelines. *Journal of Feline Medicine and Surgery* 13: 364-375. <http://dx.doi.org/10.1016/j.jfms.2011.03.012>
- Rothgerber H** 2014 A comparison of attitudes toward meat and animals among strict and semi-vegetarians. *Appetite* 72: 98-105. <http://dx.doi.org/10.1016/j.appet.2013.10.002>
- Roth-Hanania R, Davidov M and Zahn-Waxler C** 2011 Empathy development from 8 to 16 months: early signs of concern for others. *Infant Behaviour & Development* 34: 447-458. <http://dx.doi.org/10.1016/j.infbeh.2011.04.007>
- Schulte-Rüther M, Markowitsch HJ, Shah NJ, Fink GR and Piefke M** 2008 Gender differences in brain networks supporting empathy. *NeuroImage* 42: 393-403. <http://dx.doi.org/10.1016/j.neuroimage.2008.04.180>
- Serpell JA** 2003 Anthropomorphism and anthropomorphic selection: Beyond the 'cute response.' *Society & Animals* 11(1): 83-100. <http://dx.doi.org/10.1163/156853003321618864>
- Serpell JA** 2005 Factors influencing veterinary students' career choices, and attitudes to animals. *Journal of Veterinary Medical Education* 32: 491-496. <http://dx.doi.org/10.3138/jvme.32.4.491>
- Sherman BL and Serpell JA** 2008 Training veterinary students in animal behavior to preserve the human-animal bond. *Journal of Veterinary Medical Education* 35(4): 496-502. <http://dx.doi.org/10.3138/jvme.35.4.496>
- Shurtleff RS, Grant P, Zeglen ME, McCulloch WF and Bustad LK** 1983 A nationwide study of veterinary students' attitudes on ethical issues. *Journal of Veterinary Medical Education* 9: 93-96
- Signal TD and Taylor N** 2006 Attitudes to animals: Demographics within a community sample. *Society & Animals* 14(2): 147-157. <http://dx.doi.org/10.1163/156853006776778743>
- Signal TD and Taylor N** 2007 Attitude to animals and empathy: Comparing animal protection and general community samples. *Anthrozoös* 20(2): 125-130. <http://dx.doi.org/10.2752/175303707X207918>
- Steiger JH and Lind JC** 1980 Statistically-based tests for the number of common factors. *Paper presented at the Annual Spring Meeting of the Psychometric Society in Iowa City*. 30 May 1980, Iowa City, USA
- Taylor H, Williams P and Gray D** 2004 Homelessness and dog ownership: an investigation into animal empathy, attachment, crime, drug use, health and public opinion. *Anthrozoös* 17(4): 353-368. <http://dx.doi.org/10.2752/089279304785643230>
- Taylor N and Signal TD** 2005 Empathy and attitudes to animals. *Anthrozoös* 18(1): 18-27. <http://dx.doi.org/10.2752/089279305785594342>
- Templer DI, Connelly HJ, Bassman L and Hart J** 2006 Construction and validation of an animal-human continuity scale. *Social Behavior and Personality* 34(7): 769-776. <http://dx.doi.org/10.2224/sbp.2006.34.7.769>
- Westbury HR and Neumann DL** 2008 Empathy-related responses to moving film stimuli depicting human and non-human targets in negative circumstances. *Biological Psychology* 78: 66-74. <http://dx.doi.org/10.1016/j.biopsycho.2007.12.009>
- Würbel H** 2009 Ethology applied to animal ethics. *Applied Animal Behaviour Science* 118: 118-127. <http://dx.doi.org/10.1016/j.applanim.2009.02.019>