The relationship between working horse welfare state and their owners' empathy level and perception of equine pain

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Abstract

An understanding of the factors influencing the human-animal relationship is relevant in the development of welfare interventions for working equids. However, the link between the psychological attributes of animal owners, such as empathy level and pain perception, and the welfare state of working horses is yet to be studied. Here, we assessed working horse owners' empathy, their perception of equine pain and how these relate to the welfare state of their horses. The relationship between empathy and perception of equine pain was also explored. One hundred owners of working horses were studied, along with their working horses (n = 127). Self-reported rating scales were used for measuring animal-oriented empathy, human-oriented empathy and owners' perception of equine pain; higher scores in the three scales indicated higher levels of empathy and higher perception of equine pain. An animal welfare index based on direct measures was applied where higher scores indicate a poorer welfare state. Most of the owners had high levels of empathy towards both animals and humans and a high perception of equine pain. According to the animal welfare index, 15.7% of horses had a poor welfare state. Higher levels of empathy and equine pain perception in owners were correlated with a better animal welfare condition, with owner's empathy level towards animals explaining over 60% of horses' welfare. Moreover, empathy towards animals was positively correlated with human-oriented empathy and perception of equine pain. We therefore suggest that strategies oriented to improve welfare of working horses should consider education programmes aimed at promoting the development of empathy in caretakers.

Keywords: *animal welfare, empathy, human-animal empathy, human-animal interactions, pain perception, working equid*

Introduction

Working equids carry out essential functions for the livelihoods of many people across the world, often peripheral and invisible to others (Pritchard 2014). In many developing countries, these working animals are still the main source of power for transport of goods and people (Pritchard *et al* 2005), and often represent the sole source of income for their owners who depend on them for their living (Popescu & Diugan 2013). It is estimated that working equids support 600 million people worldwide, usually in poor and marginalised communities (Valette 2015); these people are affected by factors such as poverty, low social status and restricted access to resources (van Dijk 2011). Working equids owners' limited skills, knowledge and resources have been associated with negative effects on their horses' welfare (Tadich *et al* 2008). However, more recently, Lanas *et al* (2018) found no relationship between the welfare state of working horses and the social vulnerability of their owners. This suggests that other factors might be involved in determining the welfare state of these animals, and further study is required.

Proper understanding of the factors affecting the human-animal relationship is an essential component of any strategy intended to improve the welfare of animals and their caregivers (Waiblinger *et al* 2006). Research in the livestock industry has shown that the quality of the human-animal relationship between stockpeople and their animals can limit productivity and affect the welfare state of the animals (Hemsworth 2003; Kielland *et al* 2010). Pritchard *et al* (2005) reported that the assessment of the quality of the human-animal relationship in working equids is important for establishing appropriate interventions in order to improve animal welfare. The authors argue that without a minimal degree of bonding between owners and their animals, there is little motivation to improve their welfare.

To date, despite growing information on the health status of working equids and the primary risks that compromise their welfare (Pritchard *et al* 2005; Burn *et al* 2010a,b), the factors affecting the human-animal relationship and their potential implications for the welfare state of working equids have not been studied.

On the other hand, over the past thirty years, an important number of studies have established a series of human and animal factors that shape and affect the way people relate to other species (Serpell 2004; Ellingsen *et al* 2010). More recently, two important psychological factors that influence the human-animal relationship and animal welfare have been described. These are the level of human empathy (towards animals and humans) and the perception of animal pain (Signal & Taylor 2007; Ellingsen *et al* 2010; Kielland *et al* 2010). Empathy is a multidimensional construct consisting of affective and cognitive components (Shamay-Tsoory 2011) and has been defined as "the capacity to be affected by and share the emotional state of another, assess the reasons for the other's state, and identify with the other, adopting his or her perspective" (de Waal 2008); such definition has been, in some way, extended to non-human animals (Ascione 2005; p 64; Ellingsen *et al* 2010; Angantyr *et al* 2011). One of the main reasons why empathy may be important in human-animal interactions is that human empathy, apart from being positively associated with empathy towards animals (Paul 2000), has been proposed as a fundamental motivator of altruistic behaviours and as a mediating factor in aggression to both humans and animals (Zahn-Waxler & Radke-Yarrow 1990; Taylor & Signal 2005). In this sense, the association between empathy and positive attitudes and behaviours towards animals has been reported. For example, Kielland *et al* (2010) reported that empathy towards animal pain, and farmers' attitudes influence human-animal interactions, affecting farmers' behaviour towards animals and consequently animal welfare. In the same line, there is evidence of a relationship between higher scores of empathy and more intense ratings of observed pain in humans (Green *et al* 2009). A relationship between the empathy expressed by those who care for animals and the recognition of animal pain has been proposed. For example, Ellingsen *et al* (2010) reported that empathy was the best predictor of how people rated pain in dogs. A similar association of empathy towards animals and pain-scoring in cattle has been shown for veterinarians (Norring *et al* 2014). However, the relationship between human-animal empathy and owners' perception of pain in working horses, and how these two factors affect animal welfare have not been studied. Thus, the aim of this study was, first, to investigate the relationship between the welfare state of working horses and their owners' level of empathy (human-animal and human-human empathy) and perception of equine pain and, second, to explore the link between human-animal empathy with human-human empathy and perception of equine pain.

Materials and methods

This study was conducted between March 2015 and January 2016 in two administrative regions of Chile (the Metropolitana de Santiago and the Araucanía regions). All protocols were approved by the Bioethics Committee (No 06-2015) of the Veterinary Faculty, University of Chile, prior to the start of data collection.

Welfare assessment protocol

The welfare state of 127 working horses all performing urban draught work was assessed. Based on published literature, the welfare assessment protocol included one resource-based and 16 animal-based measures (Pritchard *et al* 2005; Burn *et al* 2010b; Mekuria *et al* 2013; Popespu & Diugan 2013; Popescu *et al* 2014; see Appendix 1, in the supplementary material to papers published in *Animal Welfare* section on the UFAW website; https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material).

Additional information recorded for each animal included age, sex, conformation, and estimated live weight (Appendix 1; https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). All assessments were carried out at the owner's residence; a halter was used for restraint during observation and clinical examination.

The animal welfare index developed by Lanas *et al* (2018) was applied. The index included three dimensions (Physical, Behavioural and Mental states) and within each dimension a group of welfare indicators (Appendix 1; https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). The weighting of the dimension was obtained through the Saaty process (2008) applied by Lanas *et al* (2018) and the weight of a single indicator was obtained by dividing the weight of the dimension by the number of indicators within it (Appendix 1; https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). The resulting animal welfare index ranged from 0 to 1, where higher scores indicate poor welfare; a cut-off point of > 0.333 was established to define a horse in poor welfare (which means that one-third or more of the welfare indicators assessed in an individual were found altered or outside of the normal range described for this species), then the proportion of horses in poor welfare condition was calculated.

Owner characteristics

A total of 100 working horse owners were interviewed by the observer (DL: a veterinary surgeon) in order to obtain information concerning their level of human-animal empathy, human-human empathy and pain perception towards horses. All owners signed an informed consent agreeing to participate in the survey, on the understanding that no economic benefit would be involved.

Assessment of owners' human-animal empathy

A modified version of the Animal Empathy Scale developed by Paul (2000) was used. The instrument was previously translated into Spanish and adapted by bilingual veterinarians (Beaton *et al* 2000). Empathy assessment instruments should be designed considering

the specific characteristics of the target population (Spreng *et al* 2009). For this reason, the scale was restructured as a standardised interview. During the adaptation phase of the scale, items were rephrased until the owners fully understood what was being asked. All comments about the survey were recorded. Negatively formulated items that generated confusion were not included in the final scale. The final Animal Empathy Scale (AES) applied consisted of eleven statements concerning animals, all of which suggested empathic feelings. The owners were required to respond to each statement on a nine-point Likert scale, ranging from 1 (very strongly disagree) to 9 (very strongly agree). A middle option (5) was interpreted as neutral and included to avoid forced choice. The Animal Empathy Scale scores were calculated as the sum of the eleven responses for each owner. Scores on the empathy scale can range from 11 to 99, with higher scores indicating higher levels of human-animal empathy.

Assessment of owners' human-human empathy

To determine the level of human-human empathy, an adapted version of the Davis Interpersonal Reactivity Index (IRI), validated in Chile for university students (Fernández *et al* 2011), was used. This instrument was adapted to be used as an interview. The IRI consisted of 28 items grouped into four sub-scales aimed at assessing the cognitive and affective aspects of empathy. These are: perspective-taking, fantasy, empathic concern, and personal distress (Davis 1980). The instrument scored on a five-point Likert scale ranging from 1 (does not describe me well) to 5 (describes me well). Scores on the IRI (from now on called Human Empathy Scale or HES) can range from 28 to 140, with higher scores indicating higher levels of human-human empathy.

Assessment of owners' perception of equine pain

To assess the owners' perception of the degree (or intensity) of pain felt by equines, an Owners' Perception of Equine Pain Scale (OPEPS) was applied, based on previously published studies (Ellingsen *et al* 2010; Kielland *et al* 2010; Luna *et al* 2016). The scale consisted of 17 colour photographs that showed equids suffering from a range of different conditions implying varying intensities of pain, including management procedures, infectious diseases and traumatic injuries (see Appendix 2, in the supplementary material to papers published in *Animal Welfare* section on the UFAW website; https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). The painful conditions used were selected from a larger sample, on the basis of consistency in pain intensity ratings by Chilean equine practitioners (Luna *et al* 2016) and conditions commonly reported in working horses. The order of presentation of painful conditions in the scale was randomised. Owners were instructed to rate the intensity of pain they thought the horse would feel in each situation (photograph) by selecting the facial expression that best characterised the pain intensity perceived in the photograph using a Facial Pain Scale (FPS) located beneath each photograph (Figure 1). The FPS was a five-point Likert scale with different facial expressions that represent increasing level of pain intensity

Example of one of the photographs used in the Owners' Perception of Equine Pain Scale (OPEPS) using a Facial Pain Scale (FPS) with five facial expressions that represent increasing level of pain intensity from left (1) to right (5).

from left to right where: 1 = no pain; 2 = mild pain; 3 = moderate pain; 4 = severe pain; and 5 = maximum pain. The score in OPEPS for each owner was calculated as the sum of the 17 responses. Scores on the OPEPS can range from 17 to 85, with higher scores indicating a greater perception of pain. In this study, horse owners' perception of pain intensity will be referred to as pain perception.

Data handling and statistical analysis

Data from each owner and their working horses were collated in a database in Excel® (Microsoft Office Excel® 2013) and then exported to R (www.R-project.org) for statistical analysis. Descriptive statistics were calculated to summarise information on the general and welfare characteristics of horses, the levels of empathy (human-human and human-animal empathy) and owners' perception of equine pain. The internal consistency of the three scales (AES, HES and OPEPS) was examined by calculating Cronbach's alpha coefficient (Cronbach 1951), which provides a measure of whether individual items are assessing the same psychological construct (Maio & Haddock 2009). This coefficient was calculated initially on a pilot sample of ten horse owners and afterwards with the total study sample. Spearman rank correlation test was used to establish the

Table 1   Characteristics of the working horses (n = 127) assessed in this study.

Characteristic	Descriptor	Results
Age (years)	Mean (± SD)	8.4 (± 4.4)
	Range	1.5–25
Estimated live weight (kg)	Mean (± SD)	403 (± 85)
	Range	185–632
Sex	Mares	60%
	Stallions	28%
	Geldings	13%
Anamorphosic index (type of horse)	Speed < 2.12	74%
	Draught > 2.12	26%
Animal welfare index	Mean (± SD)	0.15 (± 0.13)
	Range	0.0–0.62
	% > 0.333	15.7%

Table 2   Behavioural observations on 127 working horses, expressed in number (n) and proportion (%).

Behavioural observations	Response to owner (n; %)	Response to observer (n; %)
1) Approximation test		
Ignore	15 (11.8)	20 (15.7)
Friendly response	98 (77.1)	89 (70.1)
Avoidance	9 (7.1)	11 (8.6)
Aggressiveness	5 (3.9)	7 (5.5)
2) Walk down side		
Ignore	12 (9.4)	27 (21.2)
Friendly response	95 (74.8)	78 (61.4)
Avoidance	13 (10.2)	12 (9.4)
Aggressiveness	7 (5.5)	10 (7.8)
3) Chin contact		
Accept	104 (81.8)	98 (77.1)
Avoid	23 (18.1)	29 (22.8)
4) Pick up limb		
Accept	117 (92.1)	117 (92.1)
Avoid	10 (7.8)	10 (7.8)

presence, magnitude and direction of the relationships between human-animal empathy and the horses' welfare index; human-human empathy and welfare index; owners' perception of equine pain and welfare index; human-animal empathy and human-human empathy; and between human-animal empathy and perception of equine pain. The strength of the relationship between variables (very low = 0.00 to 0.19; low = 0.20 to 0.39; modest = 0.40 to 0.69; high = 0.70 to 0.89; very high = 0.90 to 1.00) was defined based on the Spearman rank correlation coefficient, according to Cohen and Holliday (1996). Associations between the welfare index of horses and owners' human-animal empathy were also tested with a simple linear regression model to determine whether the welfare state of horses varied according to their owners' level of human-animal empathy, and to determine the percentage of variance in welfare explained by empathy. The assumptions for a general linear model were checked by plots of residuals against predicted and expected values and normal distribution tests of residuals. The general formula used for the linear regression model is as follows:

$$WI_i = \beta_0 + \beta_1 {*} AES + e_i$$

Where WI_i is the welfare index; β_0 the intercept; AES represents the Animal Empathy Scale score; β_1 represents the regression coefficient for the AES score; and e_i is the random residual. A statistical significance level $P < 0.05$ was established.

Results

Working horse welfare assessment

The mean (± SD) age of working horses was 8.4 (± 4.4) years, ranging from 1.5 to 25 years, with a mean estimated live weight of 403 (± 85) kg; range = 185–632 kg and a predominance of mares (60%). Most horses had a speed-type conformation (74%) according to the anamorphosic index (AI) (Table 1) and were in adequate body condition (80.3%). Table 1 shows the results of the animal welfare index. Of the horses assessed, 15.7% were considered to be in a poor welfare state with scores of > 0.333. The most common health problems were hoof abnormalities (53.5%) and presence of body lesions (46.4%), mostly located on harness-related areas. Most horses had an alert attitude (94%) and presented positive responses towards their owner and the observer (Table 2). During the approximation and walk down side tests, the most frequent behaviour observed was a friendly response, especially at the owner's approach, with aggressiveness and avoidance being the least frequent responses in all tests.

Human-animal empathy, human-human empathy and owners' perception of equine pain assessment

According to the Cronbach's alpha coefficient analyses the AES (pilot sample = 0.72, total sample = 0.70) had a good level of internal reliability, while the HES (pilot sample = 0.85, total sample = 0.89) and OPEPS (pilot sample = 0.93, total sample = 0.90) had a high level of reliability. Mean, median, standard deviations, 95% confidence

intervals and ranges of the scales are shown in Table 3. The high mean scores reported in the three scales (AES, HES and OPEPS) indicate that the average working horse owner has high levels of empathy both towards animals and humans, and also a high perception of pain in horses.

Summary statistics of the 17 painful conditions used in the OPEPS are presented in Table 4. Owners' responses to the OPEPS were fairly heterogeneous; of the 17 conditions evaluated, ten (59%) were assessed with a range of pain intensity from 1 to 5. Based on the mean scores for each condition, dermatophilosis was considered the least painful condition, followed by poor trimming and shoeing, hoof overgrowth and a halter burn wound (Table 4).

The relationship between human-animal empathy, human-human empathy, perception of equine pain and welfare index

Spearman correlation was calculated between human-animal empathy scores and the animal welfare index; between human-human empathy scores and animal welfare index; and between the pain perception assessment scores and the animal welfare index. Significant, high negative correlations were found between animal welfare index and the human-animal empathy scores ($r = -0.73$; $P < 0.001$) and between the animal welfare index and pain perception scores ($r = -0.70$; $P < 0.001$). Whereas a low, but significant, negative correlation was found between the animal welfare index and the human-human empathy scores ($r = -0.32$; $P < 0.001$). It is noteworthy that the correlations are negative because the welfare index is scaled inversely to the AES, OPEPS and HES, meaning that higher levels of empathy and perception of equine pain are associated with a better animal welfare condition. Spearman correlation analyses revealed that both empathy scales (AES and HES) showed a modest significant positive correlation ($r = 0.49$; $P < 0.001$). When using Spearman correlation between human-animal empathy and pain perception scores ($r = 0.80$; $P < 0.001$), a significant high positive correlation was found. Regression analyses showed an association between the welfare index and owners' human-animal empathy, indicating that the empathy variable explains 63% of the variance of the welfare index ($R^2 = 0.63$; $AdjR^2 = 0.63$; $\beta = -0.0089$; $P < 0.001$).

Discussion

Working horses play a fundamental role in livelihoods through their direct and indirect contribution to financial, natural, physical and social capital (Pritchard 2014). The welfare state of these equids tends to be poor and has a direct impact on their health and their working capacity (Pritchard *et al* 2005; Burn *et al* 2010b; Ali *et al* 2016), compromising their own well-being and that of their owners. Several studies have focused on assessing husbandry and welfare of working equids (Pritchard *et al* 2005; Tadich *et al* 2008; Ali *et al* 2016).

In this study, we report an adequate animal welfare state in most of the working horses assessed (84.3%), based on the welfare index applied, contrary to findings of other studies

Table 3   Mean (± SD), median, 95% confidence interval, and range for study scales.

Scale	Mean (± SD)	Median	95% CI	Range
AES	81.27 (± 11.68)	83	78.95–83.58	52–99
HES	100.41 (± 20.24)	99	96.39–104.43	55–139
OPEPS	69.01 (± 9.04)	69	67.21–70.80	40–85

Animal Empathy Scale (AES), Human Empathy scale (HES) and Owners' Perception of Equine Pain Scale (OPEPS) scores for working horse owners (n = 100).

Table 4   Median, mean and range of estimated intensity of animal pain associated with 17 painful conditions (photographically illustrated) in equids.

Painful conditions	Median	Mean	Range FPS
Halter burn wound	3	2.99	1–5
Fetlock rope burn wound	4	4.14	2–5
Poor trimming and shoeing	3	2.76	1–5
Cannon and pastern rope burn wound	5	4.67	1–5
Articular capsule wound	5	4.90	3–5
Mastitis	4	3.94	1–5
Open tibia fracture	5	4.90	2–5
Castration	4	4.01	1–5
Saddle sore	4	3.78	1–5
Subsolar abscess	5	4.72	2–5
Septic arthritis in foal	5	4.81	3–5
Skin lesions on withers	5	4.68	3–5
Dermatophilosis	2	2.28	1–5
Evisceration	5	4.89	1–5
Hoof overgrowth	3	2.95	1–5
Laminitis with hoof loss	5	4.82	2–5
Pectoral burn wound	4	3.77	1–5

Factors scored by working horses owners (n = 100) using a Facial Pain Scale (FPS) from no pain (1) to maximum pain (5).

(Pritchard *et al* 2005; Burn *et al* 2010a,b). The main health problem found was hoof abnormalities, which can be attributed to the fact that shoeing of these horses is often performed by the owner (Tadich *et al* 2008), frequently depending more on wearing out of the shoes than on the hoof condition itself (Popescu & Diugan 2013). This may be due to owners' lack of understanding regarding hoof balance and care, or the lack of availability or accessibility of the service (Tadich *et al* 2008; Tadich & Stuardo-Escobar

2014). Furthermore, the results show that poor trimming and shoeing and hoof overgrowth were rated as low pain conditions. The low intensity of pain attributed to these conditions probably weakens owners' intention of improving their animals' foot health and might also contribute to the high prevalence of this condition.

Injuries in draught horses usually vary from simple wounds to deep and extensive lesions, sometimes affecting muscles and bones (Chavira-Sevilla 2003), which are seriously aggravated when the horse's body condition is poor (Pritchard *et al* 2005). In this study, despite the fact that most horses' body condition was adequate, a high percentage of animals presented skin lesions, mostly simple excoriations located at harness contact points. These results may be attributed to the fact that most horses did not have appropriate morphological characteristics to carry out draught activities. Other authors have previously suggested that poor harness-fitting or usage of inadequate harnesses can produce skin lesions on these animals (Popescu & Diugan 2013).

Behavioural tests are considered a major component in welfare assessment of working equids. These tests can help demonstrate the nature (positive, negative or neutral) of the human-equid interaction and equids' mental state (Hausberger *et al* 2008; Ali *et al* 2016). Furthermore, it has been suggested that adverse reactions shown by horses (such as avoidance and aggression) may reflect the quality and characteristics of the human-horse relationship (Henry *et al* 2005). Interestingly, in this study, most horses presented friendly behaviours towards their owner and the observer, in contrast with previous studies (Pritchard *et al* 2005; Burn *et al* 2010b; Popescu & Diugan 2013). These results suggest responsible and proper handling by horse owners, and the existence of a positive relationship characterised by a strong emotional bond between the horse and their owner, which is needed for the development of empathic skills (English 1991; Luna *et al* 2017).

The present study shows that working horse owners have high levels of human-animal empathy, according to their mean scores on the AES. Batson *et al* (1995) reported that the level of empathic response "can be used to infer how much one values the welfare of a person in need"; consequently, the high levels of empathy elicited by animals would reflect that owners value the welfare of their horses, and therefore perceive when it is affected. In the present study, the construct of human-animal empathy is not only highly correlated to the animal welfare index, but it can also explain a large proportion of the variation of the welfare state of the working horses assessed. These results are consistent with those reported by Kielland *et al* (2010) who found that high levels of empathy and positive attitudes of farmers towards animals were associated with low prevalence of skin lesions in cattle. English (1991) proposed that empathy describes an emotional attachment between humans and the animals with which they relate. Therefore, one possible explanation of these findings, and in line with Hemsworth and Coleman (2011), is that owners with higher levels of empathy are capable of generating and feeling a

stronger emotional bond with their animals, which allows them to put themselves in the animal's position. Consequently, the owner is capable of recognising and more easily understanding the reactions and needs of their horses and, therefore, is more inclined to provide them with greater attention and care when needed.

In relation to human-human empathy, this was weakly associated with the welfare index. Although, no previous studies had evaluated the link between human-oriented empathy and animal welfare, our results may be partially supported by other studies (Taylor & Signal 2005; Signal & Taylor 2007), which found that empathy towards humans was positively associated with more pro-animal welfare attitudes. Moreover, human-animal empathy was associated with human-human empathy, but only moderately, which is consistent with previous studies (Paul 2000; Norring *et al* 2014; Calderón-Amor *et al* 2017). This means that owners with higher human-animal empathy scores were also more empathic towards other humans. The modest correlation between the two scales indicates that although both instruments are related, they should not be understood as a unique construct (Paul 2000). Thus, there are other factors that affect the empathy towards animals.

During the evaluation of owners' perception of equine pain, most painful conditions showed a wide range of pain scores, as described in other studies (Ellingsen *et al* 2010; Waran *et al* 2010; Muri & Valle 2012; Luna *et al* 2016). This supports the notion that it is difficult for horse owners to recognise and assess the pain experienced by animals, probably due to the fact that the assessment of the degree of pain experienced by an animal necessarily depends on a subjective analysis (Anil *et al* 2002). This difficulty may be even greater during the evaluation of pain in prey animals, such as horses which, as part of their evolutionary strategy, may show few signs of pain to avoid appearing vulnerable to predators (Bateson 1991; Taylor *et al* 2002). However, despite the lack of consensus to qualify most of these conditions, the present study shows that working horse owners have a high perception of the degree of pain felt by horses, according to their mean score in the OPEPS. This implies that most owners tended to infer more intensely the pain in horses, regardless of whether the evaluated condition really deserves the highest rating of pain. It would be interesting, in further studies, to differentiate those owners who, despite the instructions given, were capable of really imagining how the horses perceived the situation (felt pain), and those who imagined how they themselves would have felt in the horse's position. Although, based on the study of Batson *et al* (1997), both situations might evoke feelings of empathy, they could have different consequences; the first (imagining other's position) leading to an altruistic motivation and therefore the owner tends to help the animal, while the second (imagining self), producing an increase in both empathy and personal distress, which has been found to evoke egoistic motivations to relieve one's own distress.

Our analyses showed a significant association between owners' perception of pain towards horses and the welfare

state of their working horses. These results are consistent with those reported by Kielland *et al* (2008) in which farmers' recognition of animal pain was a good predictor of welfare outcomes at farm level and a reliable predictor of the quality of human-animal interactions. It has been described that the ability to recognise pain plays a key role in the assessment and subsequent decision-making for pain alleviation in animals (Waran *et al* 2010). However, there have only been a limited number of studies in this area of research and, although causation cannot be established from our results, we suggest that improving owners' perception of pain in horses could have a positive impact on the welfare of their working horses, impact that has been previously suggested for other species (Ellingsen *et al* 2010).

Despite the suggestion that empathy is not a relevant criterion in the assessment of animal pain (see Bateson 1991), we found a high and positive correlation between perception of equine pain and human-animal empathy, supporting the notion that owners who scored higher on the empathy measure also tended to score higher on the OPEPS. These results are consistent with previous studies suggesting that higher empathy scores appear related to more intense ratings of observed pain in humans (Green *et al* 2009) and in other animal species (Ellingsen *et al* 2010; Norring *et al* 2014). Thus, our results suggest that mechanisms that mediate empathy towards animals might also be involved in the perception and evaluation of pain in them, regardless of the species of animal. These results are supported by research showing that perceiving and assessing painful situations in humans was associated with changes in activity in several brain areas that are involved in empathic responses (Singer *et al* 2004; Jackson *et al* 2005). Moreover, the perception and assessment of pain in others may trigger an affective state of arousal, such as distress and anxiety, from which empathic response may stem (Eisenberg 2000; Jackson *et al* 2005). For this reason, one of the approaches used to investigate empathy towards humans and animals is the observed responses of subjects towards pictures of individuals or animals in situations that could be associated with pain (Westbury & Neumann 2008; Kielland *et al* 2010; Muri & Valle 2012). Thus, there is a considerable amount of evidence supporting the notion that high levels of empathy will be accompanied by a greater pain perception given the intrinsic relationship between both variables, as reported in this study.

There are, however, a number of limitations to the current study that must be taken into consideration. Firstly, the measures for both empathy and perception of pain in horses were self-reported. There are known issues associated with self-reported methods, such as social desirability bias, which is the tendency of respondents to answer in a socially acceptable manner (Holtgraves 2004). Therefore, future research should focus on assessing empathy and perception of equine pain in this population using other types of measures, such as psychophysiological measures (eg neuroimaging studies, facial electromyographic activity, or electrodermal activity). Secondly, although cultural differ-

ences have been reported, both in human empathy (Cassels *et al* 2010) and in attitudes toward animals (Pifer *et al* 1994), to our knowledge, no previous research has determined the role of cultural differences in human-animal empathy and its relationship to animal welfare. Thus, future work should further examine the relationship between empathy towards animals and animal welfare in those countries possessing a large quantity of working horses.

Animal welfare implications and conclusion

This is the first study to establish the association between high levels of owners' human-animal empathy and perception of equine pain on working horses' welfare status. Our findings support the notion that owners with higher levels of empathy towards animals maintain their horses in a better state of welfare. Therefore, strategies oriented towards improving the welfare state of working horses should consider the inclusion of education programmes aimed at promoting and stimulating empathy development in owners, in order to generate positive interactions, improve the bond with their animals, and consequently improve animals' well-being. On the other hand, the study also shows that empathy towards animals was associated with empathy towards humans and owners' perception of pain in horses, suggesting an intrinsic relationship between the three constructs. Future research should aim at increasing knowledge regarding these aspects of human-animal interactions, and examine possible associations between empathy, perception of equine pain and owners' demographic variables.

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References

Ali AB, El Sayed MA, Matoock MY, Fouad MA and Heleski CR 2016 A welfare assessment scoring system for working equids. A method for identifying at risk populations and for monitoring progress of welfare enhancement strategies (trialed in Egypt). *Applied Animal Behaviour Science 176*: 52-62. https://doi.org/10.1016/j.applanim.2015.12.001

Angantyr M, Eklund J and Hansen EM 2011 A comparison of empathy for humans and empathy for animals. *Anthrozoös 24*: 369-377. https://doi.org/10.2752/175303711X13159027359764

Anil S, Anil L and Deen J 2002 Challenges of pain assessment in domestic animals. *Journal of the American Veterinary Medical Association 220*: 313-319. https://doi.org/10.2460/javma.2002.220.313

Ascione FR 2005 *Children and Animals: Exploring the Roots of Kindness and Cruelty* pp 66-88. Purdue University Press: West Lafayette, IN, USA

Bateson P 1991 Assessment of pain in animals. *Animal Behaviour 42*: 827-839. https://doi.org/10.1016/S0003-3472(05)80127-7

Batson CD, Early S and Salvarani G 1997 Perspective taking: Imagining how another feels versus imaging how you would feel. *Personality and Social Psychology Bulletin 23*: 751-758. https://doi.org/10.1177/0146167297237008

Batson CD, Turk CL, Shaw LL and Klein TR 1995 Information function of empathic emotion: Learning that we value the other's welfare. *Journal of Personality and Social Psychology 68*: 300-313. https://doi.org/10.1037/0022-3514.68.2.300

Beaton DE, Bombardier C, Guillemin F and Ferraz MB 2000 Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine 25*: 3186-3191. https://doi.org/10.1097/00007632-200012150-00014

Burn CC, Dennison TL and Whay HR 2010a Environmental and demographic risk factors for poor welfare in working horses, donkeys and mules in developing countries. *The Veterinary Journal 186*: 385-392. https://doi.org/10.1016/j.tvjl.2009.09.016

Burn CC, Dennison TL and Whay HR 2010b Relationship between behaviour and health in working horses, donkeys, and mules in developing countries. *Applied Animal Behaviour Science 126*: 109-118. https://doi.org/10.1016/j.applanim.2010.06.007

Calderón-Amor J, Luna-Fernández D and Tadich T 2017 Study of the levels of human-human and human-animal empathy in veterinary medical students from Chile. *Journal of Veterinary Medical Education 44*: 179-186. https://doi.org/10.3138/jvme.0216-038R

Cassai G 1944 El caballo de Labranza. *Revista El Campesino 96*: 7-10. [Title translation: The Labranza horse]

Cassels TG, Chan S and Chung W 2010 The role of culture in affective empathy: Cultural and bicultural differences. *Journal of Cognition and Culture 10*: 309-326. https://doi.org/10.1163/156853710X531203

Chavira-Sevilla H 2003 Points which should be considered regarding the use of harnesses and implements in working equines. *Fourth International Colloquium on Working Equines*. 20-25 April 2003, Hama, Syria

Cohen L and Holliday M 1996 *Practical Statistics for Students: An Introductory Text*. Paul Chapman Publishing: London, UK. https://doi.org/10.4135/9781849209571

Crane M 1997 Medical care of donkeys. In: Svendsen E (ed) *The Professional Handbook of the Donkey* pp 19-36. Whittet Books Limited: London, UK

Cronbach LJ 1951 Coefficient alpha and the internal structure of tests. *Psychometrika 16*: 297-334. https://doi.org/10.1007/BF02310555

Davis MH 1980 Multidimensional approach to individual differences in empathy. *Catalogue of Selected Documents in Psychology 10*: 85-104

de Waal FB 2008 Putting the altruism back into altruism: the evolution of empathy. *Annual Review of Psychology 59*: 279-300. https://doi.org/10.1146/annurev.psych.59.103006.093625

Eisenberg N 2000 Emotion, regulation, and moral development. *Annual Review of Psychology 51*: 665-697. https://doi.org/10.1146/annurev.psych.51.1.665

Ellingsen K, Zanella AJ, Bjerkås E and Indrebø A 2010 The relationship between empathy, perception of pain and attitudes toward pets among Norwegian dog owners. *Anthrozoös 23*: 231-243. https://doi.org/10.2752/175303710X12750451258931

English PR 1991 Stockmanship, empathy, and pig behaviour. *Pig Veterinary Journal 26*: 56-66

Fernández AM, Dufey M and Kramp U 2011 Testing the psychometric properties of the Interpersonal Reactivity Index (IRI) in Chile: Empathy in a different cultural context. *European Journal of Psychological Assessment 27*: 179-185. https://doi.org/10.1027/1015-5759/a000065

Green AD, Tripp DA, Sullivan MJL and Davidson M 2009 The relationship between empathy and estimates of observed pain. *Pain Medicine 10*: 381-392. https://doi.org/10.1111/j.1526-4637.2009.00563.x

Hausberger M, Roche H, Henry S and Visser EK 2008 A review of the human-horse relationship. *Applied Animal Behaviour Science 109*: 1-24. https://doi.org/10.1016/j.applanim.2007.04.015

Hemsworth PH 2003 Human-animal interactions in livestock production. *Applied Animal Behaviour Science 81*: 185-198. https://doi.org/10.1016/S0168-1591(02)00280-0

Hemsworth PH and Coleman GJ 2011 *Human-livestock Interaction: The Stockperson and the Productivity and Welfare of Intensively Farmed Animals, Second Edition* pp 1-20. CAB International: Wallingford, UK. https://doi.org/10.1079/9781845936730.0000

Henry S, Hemery D, Richard MA and Hausberger M 2005 Human-mare relationships and behaviour of foals toward humans. *Applied Animal Behaviour Science 93*: 341-362. https://doi.org/10.1016/j.applanim.2005.01.008

Holtgraves T 2004 Social desirability and self-reports: Testing models of socially desirable responding. *Personality and Social Psychology Bulletin 30*: 161-172. https://doi.org/10.1177/0146167203259930

Jackson PL, Meltzoff AN and Decety J 2005 How do we perceive the pain of others? A window into the neural processes involved in empathy. *Neuroimage 24*: 771-779. https://doi.org/10.1016/j.neuroimage.2004.09.006

Kielland C, Skjerve E, Østerås O and Zanella AJ 2008 Dairy farmers' assessment of animal pain, using a photo-based instrument, can predict animal welfare outcomes at farm level. *Proceedings of the 42nd Congress of the International Society for Applied Ethology*. 5-9 August 2008, Dublin, Republic of Ireland

Kielland C, Skjerve E, Østerås O and Zanella AJ 2010 Dairy farmer attitudes and empathy toward animals are associated with animal welfare indicators. *Journal of Dairy Science 93*: 2998-3006. https://doi.org/10.3168/jds.2009-2899

Knottenbelt DC 2006 *Saunders Equine Formulary*. Saunders Elsevier: Edinburgh, UK

Lanas R, Luna D and Tadich T 2018 The relationship between working horse welfare and their owners socio-economic status. *Animal Welfare 18*: 27-54. https://doi.org/10.7120/09627286.27.1.047

Luna D, Vásquez RA, Rojas M and Tadich TA 2017 Welfare status of working horses and owners' perceptions of their animals. *Animals 7*: 56. https://doi.org/10.3390/ani7080056

Luna D, Yañez JM and Tadich T 2016 Level of agreement in the recognition of pain among equine practitioners in Chile. *Veterinaria México OA 3*: 1-8

Maio GR and Haddock G 2009 *The Psychology of Attitudes and Attitude Change, First Edition*. SAGE Publications Ltd: London, UK

Mekuria S, Mulachew M and Abebe R 2013. Management practices and welfare problems encountered on working equids in Hawassa town, Southern Ethiopia. *Journal of Veterinary Medicine and Animal Health 5*: 243-250

Meyer K 1992 *A study of the condition of working horses in Chile*. PhD Thesis, University College of North Wales, Bangor, Gwynedd, UK

Muri K and Valle PS 2012 Human-animal relationships in the Norwegian dairy goat industry: assessment of pain and provision of veterinary treatment (Part II). *Animal Welfare 21*: 547-558. https://doi.org/10.7120/09627286.21.4.547

Norring M, Wikman I, Hokkanen AH, Kujala MV and Hänninen L 2014 Empathic veterinarians score cattle pain higher. *The Veterinary Journal 200*: 186-190. https://doi.org/10.1016/j.tvjl.2014.02.005

Paul ES 2000 Empathy with animals and with humans: Are they linked? *Anthrozoös 13*: 194-202. https://doi.org/10.2752/089279300786999699

Pifer L, Shimizu K and Pifer R 1994 Public attitudes toward animal research: Some international comparisons. *Society & Animals 2*: 95-113. https://doi.org/10.1163/156853094X00126

Popescu S and Diugan EA 2013 The relationship between behavioral and other welfare indicators of working horses. *Journal of Equine Veterinary Science 33*: 1-12. https://doi.org/10.1016/j.jevs.2012.04.001

Popescu S, Diugan EA and Spinu M 2014 The interrelations of good welfare indicators assessed in working horses and their relationships with the type of work. *Research in Veterinary Science 96*: 406-414. https://doi.org/10.1016/j.rvsc.2013.12.014

Pritchard J 2014 What role do working equids play in human livelihoods, and how well is this currently recognised? *Proceedings of the 7th International Colloquium on Working Equids*. 1-3 July 2014, Royal Holloway, University of London, UK

Pritchard JC, Lindberg AC, Main DCJ and Whay HR 2005 Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. *Preventive Veterinary Medicine 69*: 265-283. https://doi.org/10.1016/j.prevetmed.2005.02.002

Saaty TL 2008 Decision making with the analytic hierarchy process. *International Journal of Services Sciences 1*: 83-98. https://doi.org/10.1504/IJSSCI.2008.017590

Serpell JA 2004 Factors influencing human attitudes to animals and their welfare. *Animal Welfare 13*: 145-151

Shamay-Tsoory SG 2011 The neural bases for empathy. *The Neuroscientist 17*: 18-24. https://doi.org/10.1177/1073858410379268

Signal TD and Taylor N 2007 Attitude to animals and empathy: Comparing animal protection and general community samples. *Anthrozoös 20*: 125-130. https://doi.org/10.2752/175303707X207918

Singer T, Seymour B, O'Doherty J, Kaube H, Dolan RJ and Frith CD 2004 Empathy for pain involves the affective but not sensory components of pain. *Science 303*: 1157-1162. https://doi.org/10.1126/science.1093535

Spreng RN, McKinnon MC, Mar RA and Levine B 2009 The Toronto Empathy Questionnaire: Scale development and initial validation of a factor-analytic solution to multiple empathy measures. *Journal of Personality Assessment 91*: 62-71. https://doi.org/10.1080/00223890802484381

Tadich T, Escobar A and Pearson RA 2008 Husbandry and welfare aspects of urban draught horses in the south of Chile. *Archivos de Medicina Veterinaria 40*: 267-273. https://doi.org/10.4067/S0301-732X2008000300007

Tadich TA and Stuardo-Escobar LH 2014 Strategies for improving the welfare of working equids in the Americas: a Chilean example. *Revue Scientifique et Technique (International Office of Epizootics) 33*: 203-211. https://doi.org/10.20506/rst.33.1.2271

Taylor N and Signal TD 2005 Empathy and attitudes towards animals. *Anthrozoös 18*: 18-27. https://doi.org/10.2752/089279305785594342

Taylor PM, Pascoe PJ and Mama KR 2002 Diagnosing and treating pain in the horse. Where are we today? *Veterinary Clinics of North America: Equine Practice 18*: 1-19. https://doi.org/10.1016/S0749-0739(02)00009-3

Valette 2015 *Invisible workers: The economic contributions of working donkeys, horses and mules to livelihoods*. The Brooke: London, UK

van Dijk L 2011 Socio-cultural and environmental impact of working animals on livelihoods. *Expert Meeting on the Role, Impact and Welfare of Working (Transport and Traction) Animals*. 13-17 June 2011, FAO/The Brooke, Rome, Italy

Waiblinger S, Boivin X, Pedersen V, Tosi MV, Janczak AM, Visser EK and Jones RB 2006 Assessing the human-animal relationship in farmed species: a critical review. *Applied Animal Behaviour Science 101*: 185-242. https://doi.org/10.1016/j.applanim.2006.02.001

Waran N, Williams VM, Clarke N and Bridge IS 2010 Recognition of pain and use of analgesia in horses by veterinarians in New Zealand. *New Zealand Veterinary Journal 58*: 274-280. https://doi.org/10.1080/00480169.2010.69402

Westbury HR and Neumann DL 2008 Empathy-related responses to moving film stimuli depicting human and non-human animal targets in negative circumstances. *Biological Psychology 78*: 66-74. https://doi.org/10.1016/j.biopsycho.2007.12.009

Zahn-Waxler C and Radke-Yarrow M 1990 The origins of empathic concern. *Motivation and Emotion 14*: 107-130. https://doi.org/10.1007/BF00991639