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Published in:
Anthrozoös

DOI:
10.1080/08927936.2020.1694304

First published: 17/01/2020

Document Version
Peer reviewed version

Belief in pigs' capacity to suffer: an assessment of pig farmers, veterinarians, students and citizens

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The authors declare no conflict of interest.

Manuscript word count: 6443 (Excluding tables/ reference list. Including references in the text)

Abstract

Intensive animal production practices lead to animal suffering worldwide. This study examines whether farmers cope with the negative impact of farming practices on their animals by ascribing them less capacity to suffer compared to other species. Most people like eating meat, but find animal suffering emotionally disturbing. Human omnivores employ a variety of strategies to navigate this 'meat-paradox', and one of these strategies is to reduce their perception of the animal's capacity to suffer. Psychological defenses associated with meat-eating have been widely researched, but this study provides the first investigation into how these psychological defences are employed amongst those involved in meat-production, and focusses on intensive pig producers as an example. Seventy-six pig farmers reported their belief in pigs' capacity to experience pain, hunger, fear and boredom in a paper-based survey employing visual analogue scales. Their responses were compared to their perceptions of livestock that they did not farm (cows) and two companion animal species (dogs and cats). These results were compared to groups with similar experience of working with pigs (15 specialised pig veterinarians) and without experience (23 agricultural students, 22 animal science students, and 58 citizens unrelated to agriculture). The results of the 194 responses provide evidence to suggest that pig farmers do not ascribe their animals' diminished capacity to suffer. Rather, pig farmers expressed enhanced belief in pigs' capacity to experience hunger. All comparison groups expressed widespread belief in each species' capacity to suffer. Nevertheless, dogs were the species judged to be most capable of suffering, and animal science students gave the highest suffering scores overall. Farmers are directly responsible for the welfare of their animals, and further investigation into the psychological and behavioural strategies of farmers may provide insight into non-financial reasons behind the generally slow progress in improving animal welfare.

Keywords: Animal sentience; Animal welfare; Cognitive dissonance; Farmers.

Introduction

Animal production is at an all-time high. World pork production doubled between 1985 and 2016 (Food and Agriculture Organization of the United Nations., 2018). Today over 1.3 billion pigs are slaughtered worldwide each year and production is expected to continue rising (OECD/FAO, 2018). Growing demand for animal products over recent decades has been driven by the growing human population (Gelbard, Haub, & Kent, 1999; Godfray et al., 2010), and by growing consumption of meat as a result of increased incomes and urbanization (Delgado, 2003; Steinfeld, Wassenaar, & Jutzi, 2006). Demand for low-cost meat has driven intensification in some livestock sectors and low-input extensification in others (Steinfeld et al., 2006). Across the modern livestock sectors, economic market-driven constraints limit options for safeguarding animal welfare where this requires increases in fixed or variable costs. In the global commercial pig industry, the majority of animals are housed in indoor, intensive units with high stocking densities. These systems are sophisticated and highly engineered; designed for efficiency and maximum production at minimum cost. Nevertheless such intensive systems are associated with numerous threats to animal welfare and this paper examines whether pig farmers cope with the impact of the farming system on their animals by ascribing them less capacity to suffer compared to other species.

Although intensive systems offer some welfare advantages (e.g. easy health inspection, controlled climate) pigs experience injuries, pain and stress caused by aggression (Peden, Turner, Boyle, & Camerlink, 2018), tail biting (D'Eath et al., 2016), lameness (KilBride, Gillman, & Green, 2009), routine husbandry procedures such as tail docking (Wilson, Holyoake, Cronin, & Doyle, 2014) and lack of opportunity to display innate behaviours

(Taylor, Main, Mendl, & Edwards, 2010). Breeding sow welfare is further challenged by the use of farrowing crates, the continued use of sow stalls in some countries (Baxter, Lawrence, & Edwards, 2012) and chronic hunger as a result of restricted diets (D'Eath, Jarvis, Baxter, & Houdijk, 2018; Meunier-Salaun, Edwards, & Robert, 2001). Therefore, adjustments to production practices to meet the growing consumer demand for low-cost meat is a leading cause of pig suffering worldwide.

Meanwhile, affectionate relationships between humans and companion animals are a fundamental part of contemporary life (Walsh, 2009). Pet ownership is increasing (European Pet Food Federation, 2016) and pet animals are commonly considered to be family members (Cohen, 2002). Most people find animal suffering emotionally disturbing, and disapprove of harming animals (Braithwaite & Braithwaite, 1982; Schröder & McEachern, 2004). However, this disapproval rarely translates into ethical buying behaviour (Carrington, Neville, & Whitwell, 2010; Schröder & McEachern, 2004; Te Velde, Aarts, & Van Woerkum, 2002). Therefore, many people hold inconsistent but simultaneous beliefs regarding animals; they have an aversion to harming animals but like animal products (Bastian & Loughnan, 2017; Loughnan, Haslam, & Bastian, 2010).

The psychological conflict between peoples' dietary preference for meat and their moral response to animal suffering is termed "the meat-paradox" (Bastian & Loughnan, 2017; Loughnan et al., 2010). The inconsistencies between beliefs and behaviour result in an unpleasant emotional state known as cognitive dissonance, whereby people become motivated to alter one of the inconsistent elements (Festinger, 1957). Some people alter their behaviour by avoiding eating meat, and indeed most vegetarians in Western societies report moral concern for animals as a major factor in their dietary choice (Fox & Ward, 2008;

Hussar & Harris, 2010). However, most people continue to eat meat, and whilst some make ethical buying decisions, many do not and employ a number of psychological defences in order to reduce cognitive dissonance. One of the main defences employed by humans eating meat is the mental disengagement of *meat* from *animal*. Physical distance and lack of transparency in animal production allows consumers to avoid considering how animals are farmed (Hoogland, de Boer, & Boersema, 2005; Schröder & McEachern, 2004). Moreover, meat products are marketed, packaged, and sold in a way that does not remind the consumer of the animal from which it came (Hoogland et al., 2005) and this reduces consumer empathy and disgust (Kunst & Hohle, 2016). In some countries the association is broken further through the use of language e.g. we eat "beef" and "pork" instead of cattle and pigs (Bastian & Loughnan, 2017). Therefore, disengagement from animal production allows consumers to buy and eat meat frequently with little, or no discomfort (Bastian & Loughnan, 2017) or consideration of livestock suffering (Carrington et al., 2010). However, consumers are not always able to avoid the link between meat and animals and when forced to consider the animal-meat link one resolution is to alter beliefs about livestock. Several studies reveal that livestock are ascribed diminished mental states necessary to experience suffering (Bastian, Loughnan, Haslam, & Radke, 2012; Bilewicz, Imhoff, & Drogosz, 2011; Bratanova, Loughnan, & Bastian, 2011; Loughnan et al., 2010; Wilkins, McCrae, & McBride, 2015). Capacity to suffer has long been emphasised as the basis of moral concern for animals. This was famously articulated by philosopher Jeremy Bentham when he stated: *'The question is not, Can they reason? nor, Can they talk? but, Can they suffer?*' (Bentham, 1823). Therefore, by denying livestock the capacity to suffer, many omnivores restrict moral concern for animals, allowing them to eat animals without experiencing discomfort.

Farmers are a fundamental component of livestock production systems; they are responsible for all aspects of animal husbandry, including the routine administration of painful procedures such as tail docking and teeth clipping. Therefore, farmers have heightened awareness of animal suffering and, unlike consumers, they are unable to rely on the mental disengagement of *meat* from *animal*. This regular, direct exposure and participation in animal production may leave farmers particularly susceptible to high levels of cognitive dissonance. Psychological defenses employed to resolve dissonance have been widely researched in consumers without a farming background. However, no research has investigated how these psychological defences are employed by farmers in spite of the important implications for farm animal welfare. Specifically, farmers who ascribe their animals less capacity to suffer may be less inclined to make animal welfare improvements, and this may contribute to the generally slow progress in improving animal welfare (Millman, Duncan, Stauffacher, & Stookey, 2004; Peden et al., 2018). This study provides the first investigation into dissonance reducing strategies employed by farmers and focusses on intensive pig producers as an example. We hypothesized: 1) that pig farmers will ascribe pigs diminished mental states necessary to experience suffering as compared to other species; and 2) that pig farmers will ascribe pigs with less capacity to suffer as compared to citizens unrelated to pig husbandry.

Methods

Overview

The current study investigated pig farmers' perceptions of pigs' capacity to suffer through a paper-based animal suffering questionnaire. This was compared to that of cows (a livestock species that they do not farm) and to cats and dogs (companion animal species). Moreover,

148 farmer responses were compared to those of animal science students, agricultural students,
149 specialised pig veterinarians and citizens unrelated to agriculture.

150

151 **Questionnaire**

152 The paper-based questionnaire consisted of two parts. The first part collected demographic
153 information on age, gender, location (England, Scotland, Wales, Northern Ireland, Republic
154 of Ireland) and experience of working with pigs. Farmers were also asked for their role on the
155 farm, students were asked for their course title and year of study, and citizens were asked for
156 their occupation. The second part was on animal suffering. The questions were designed and
157 used in previous research with students (Paul & Podberscek, 2000) and measured participant
158 belief in the capacity of each of four species (dogs, cats, pigs, cows) to feel the sensations of
159 hunger and pain, and emotions of fear and boredom. These sensations and emotions provide a
160 brief but representative assessment of participant belief in animals' capacity to experience
161 suffering and are relevant to the challenges imposed by commercial pig production.
162 Participants indicated their responses by placing a vertical line at the point they felt most
163 appropriate on a 100mm visual analogue scale (VAS) from *'no, not at all'* to *'yes, in a very*
164 *similar way to people'*. Scores were obtained by measuring the distance from the left end of
165 the response line to the centre of the respondents' line. This process generated individual
166 scores for hunger, pain, fear and boredom for each of the four familiar, domestic species. The
167 survey was piloted with 3 pig farmers and 7 researchers and amended according to their
168 feedback regarding the wording and appropriateness of questions. The final version of the
169 questionnaire received internal ethical approval from the Human Ethical Review Committee
170 at the University of Edinburgh. Informed consent was obtained from all participants.

171

Recruitment

Participants were recruited between January 2017 and June 2018. Seventy-seven pig farmers were recruited at farmer events held by Scotland's Rural College (n=21), Teagasc (n=27) and the Agricultural and Horticultural Development Board (AHDB) Pork (n=29). Specialised pig veterinarians (n=16) were recruited at the same farmer events (n=11) and through snowball sampling (n=5) whereby veterinarian participants recruited other veterinarians. Snowball sampling is an established technique for recruiting hard-to-reach or specialised demographics (Babbie, 2010). We recruited fully qualified specialised pig veterinarians rather than veterinary students since previous research employing the same animal suffering survey found that veterinary students change their perceptions over the course of their studies (Paul & Podberscek, 2000). Furthermore, veterinarians provide an interesting comparison group due to their comparable years' experience working in the pig industry as the farmers. Undergraduate students of Animal Science (n=24) and Agriculture (n=32) courses were recruited following scheduled lectures and field trips held at Scotland's Rural College. The student populations provide interesting comparison groups because of their knowledge of farming and animals, and lack of direct work experience with pigs. Moreover, the students' perceptions of animal capacity to suffer are important as they are likely to work with animals in the future. As a control group, sixty-six citizens unrelated to agriculture were recruited through snowball sampling by one staff member and six PhD students. They recruited friends and relatives in their hometowns to fill out the survey and the friends and relatives in turn recruited further participants. It is possible that citizens shared some values with researchers which may have influenced their results. However, this method of recruitment was used in previous published research studying attitudes towards animal welfare (You, Li, Zhang, Yan, & Zhao, 2014), and allowed us to recruit people from across the UK and Ireland who did not know the purpose of the study. Furthermore, this method of recruitment avoided participant

197 self-selection based on interest in the study content (e.g., it is likely that only participants
198 interested in animals would respond to advertisements). Citizens unrelated to agriculture
199 provide an important comparison group as they had no specialisation or experience within the
200 pig industry.
201
202 **Demographics of the final sample**
203 Two applied animal science students, nine agricultural students and seven citizens were
204 eliminated from the analysis due to reporting previous experience working with pigs. One
205 farmer, one specialised pig veterinarian and one citizen were also eliminated due to missing
206 answers. In total 194 participants (demographics described below) were included. See Table
207 1 for participants' age, gender, and experience working with pigs.

208 ***Insert Table 1***

209 1) Pig farmers (n=76) were located in England (n=28), Scotland (n=21) and the Republic of
210 Ireland (n=27). Farm size varied widely (Table 2) which is consistent with the structure of the
211 industry (AHDB, 2014, 2015). Farmers were employed in a range of roles on the farm (Table
212 1) and were roughly representative of UK agricultural workers which are majority male with
213 median age 59 (Defra, 2017).

214 2) Applied Animal Science students (n=22) were all based in Scotland and studying at
215 Scotland's Rural College (SRUC). They were predominantly female (Table 1). This was
216 observed previously in animal science student groups (Heleski & Zanella, 2006). Fourteen
217 were in the third year and eight were in the fourth and final year of their course.

218 3) Agricultural students (n=23) were all based in Scotland and studying at SRUC. Twenty
219 were in the third year and three were in the fourth year of their course.

4) Specialised pig veterinarians (n=15) were based in Scotland (n=5), England (n=9) and the Republic of Ireland (n=1).

5) Citizens unrelated to agriculture (n=58) were based in Scotland (n=12), England (n=40) and the Republic of Ireland (n=6). They were employed in a range of industries which roughly fell into the following categories: education (n=3); childcare (n=3); administration (n=7); management (n=5); beauty therapy (n=4); skilled trade/ labour (n=7); engineering (n=2); marketing/ design (n=3); healthcare (n=8) and being retired (n=16). The sample is roughly representative of the UK population whereby 75.6% are employed across a range of industries (Office for National Statistics, 2018) and 18% exceed traditional working age (Office for National Statistics, 2017); however our sample was skewed towards females (Table 1).

Insert Table 2

Statistical Analysis

All statistical analyses were carried out in IBM Statistics SPSS 25. Residual maximal likelihood (REML) analysis was used to analyse the data as it does not require a balanced design and is well-suited for studies with unequal group sizes, such as this one. Furthermore, REML allowed us to control for extraneous variables (gender, age and location). Four REML models were run to investigate the factors that influence scores for the species' ability to experience: 1) hunger; 2) pain; 3) fear and; 4) boredom. These were treated as four separate response variables. Fixed effects in the models were gender (male, female), age, location (England, Scotland, Ireland), species (dog, cat, cow, pig) and occupation (farmer, specialised pig veterinarian, applied animal science student, agricultural student, citizen unrelated to agriculture). It was important to include gender, age and location first in each model in order

to control for the important demographic differences between our comparison groups. To test hypotheses 1 and 2, the interactions between occupation and species were investigated. If the hypotheses were met we would expect an interaction to occur and that the effect should reside with farmers devaluing pig ratings in comparison to other species (hypothesis 1) and citizens unrelated to agriculture (hypothesis 2). Non-significant interactions and fixed effects were removed and the model re-run in order to maximise our ability to robustly test the effect of the remaining terms in the model. Inspection of the Akaike information criterion (AIC) values confirmed that the inclusion of non-significant terms did not improve model fit. We detected a significant interaction between species and occupation for hunger score and investigated this further by running five one-way repeated measures ANOVAs to explore the effect of species (dog, cat, pig, cow) on hunger score for: 1) farmers; 2) specialised pig veterinarians; 3) agricultural students; 4) applied animal science students; and; 5) citizens unrelated to agriculture (further investigating hypothesis 1). We also ran four one-way ANOVAs to explore the effect of occupation (farmers, specialised pig veterinarians, agricultural students, applied animal science students, citizens unrelated to agriculture) on hunger scores for: 1) dogs; 2) cats; 3) cows; 4) pigs (further investigating hypothesis 2). Although the main effects of occupation, species, gender, age and location were not directly related to our hypotheses, significant main effects were followed up with post-hoc analyses, and results are reported in order to aid interpretation of the data and contribute to the literature regarding human perceptions of animals. All post-hoc analyses were conducted using least significant difference (LSD) tests with Bonferroni adjustments made for multiple comparisons. Results were considered significant where $p < 0.05$.

Results

Mean judgements of animal capacity to experience hunger, pain, fear and boredom for each occupation and species can be observed in Table 3.

Insert Table 3

Test of hypotheses

To test hypotheses 1 and 2, the interactions between occupation and species were investigated. There were no significant interactions between occupation and species on scores for pain, fear and boredom; indicating that the effect of species on scores for pain, fear and boredom did not depend on occupation. There was a significant interaction between occupation and species for hunger score (Table 4) and ANOVA analysis was employed to investigate if this interaction was determined by species (H_1) and occupation (H_2).

Insert Table 4

Test of Hypothesis 1

One-way repeated measures ANOVAs revealed a significant effect of species on hunger score for farmers ($F(3, 225) = 5.626$, $P<0.01$) and citizens unrelated to agriculture ($F(3, 171) = 9.276$, $p < 0.0001$). Farmers assigned pigs a greater capacity to experience hunger than dogs (mean difference = 5.3; SE = 1.6; 95% CI = 0.9 to 9.8; $p < 0.05$), cats (mean difference = 6.4; SE = 1.7; 95% CI = 1.7 to 11.1; $p < 0.01$), and cows (mean difference = 4.0; SE = 1.5; 95% CI = 0.0 to 8.0; approaching significance at $p = 0.051$). Citizens unrelated to agriculture judged cows as less capable of experiencing hunger than dogs (mean difference = 11.1; SE = 2.6; 95% CI = 3.9 to 18.2; $p < 0.01$), cats (mean difference = 8.7; SE = 2.5; 95% CI = 1.9 to 15.4; $p < 0.01$) and pigs (mean difference = 6.0; SE = 2.1, 95% CI = 0.2 to 11.9; $p < 0.05$). All other occupations gave comparable hunger scores to each species ($p > 0.05$). Therefore, farmers did not diminish scores for pigs compared to other species and this does not support

our first hypothesis (H_1: Pig farmers will ascribe pigs diminished mental states necessary to experience suffering as compared to other species*).*

Test of Hypothesis 2

One-way ANOVA analysis revealed a significant effect of occupation on hunger score for dogs ($F(4, 189) = 2.832$, $p < 0.05$), cats ($F(4, 189) = 3.076$, $p < 0.05$), cows ($F(4, 189) = 4.739$, $p < 0.01$) and pigs ($F(4, 189) = 3.185$, $p < 0.05$). Post-hoc analysis revealed that these significant effects were determined by applied animal science students judging dog capacity for hunger to be greater than scored by farmers (mean difference = 11.5; SE = 3.6; 95% CI = 1.2 to 21.7; $p < 0.05$); cat capacity for hunger to be greater than scored by farmers (mean difference = 12.2; SE = 3.8; 95% CI = 1.3 to 27.8; $p < 0.05$) and agriculture students (mean difference = 14.3; SE = 4.7; 95% CI = 0.9 to 27.8; $p < 0.05$); and cow (mean difference = 17.6; SE = 4.4; 95% CI = 5.2 to 30.1; $p < 0.01$) and pig (mean difference = 11.3; SE = 3.4; 95% CI = 1.6 to 21.0; $p < 0.05$) capacity for hunger to be greater than ascribed by citizens unrelated to agriculture. Therefore, farmers did not diminish scores for pigs when compared to citizens unrelated to agriculture and this does not support our second hypothesis (H_2: Pig farmers will ascribe pigs with less capacity to suffer as compared to citizens unrelated to pig husbandry).

Tests of main effects

The results of main effects in each REML model are reported here.

Main effects of occupation

There were significant main effects of occupation on scores for hunger, pain, fear and boredom across all species (Tables 3 and 4). Applied animal science students scored capacity for hunger to be higher than farmers (mean difference = 6.9; SE = 2.0; 95% CI = 1.2 to 12.7; $p < 0.01$), agriculture students (mean difference = 9.2; SE = 2.3; 95% CI = 2.7 to 15.6; $p < 0.01$) and citizens unrelated to agriculture (mean difference = 7.2; SE = 2.3; 95% CI = 0.7 to 13.6; $p < 0.05$); pain to be higher than that scored by farmers (mean difference = 8.5; SE = 2.2; 95% CI = 2.2 to 14.7; $p < 0.01$) and citizens unrelated to agriculture (mean difference = 8.8; SE = 2.1; 95% CI = 2.8 to 14.8; $p < 0.001$); and fear to be higher than scored by farmers (mean difference = 10.5; SE = 2.2; 95% CI = 4.3 to 16.6; $p < 0.001$), specialised pig veterinarians (mean difference = 8.5; SE = 3.0; 95% CI = 0.0 to 17.0; $p < 0.05$), agriculture students (mean difference = 8.2; SE = 2.7; 95% CI = 0.7 to 15.8; $p < 0.05$) and citizens unrelated to agriculture (mean difference = 13.3; SE = 2.3; 95% CI = 7.0 to 19.7; $p < 0.001$). Applied animal science students also scored the capacity for boredom to be higher than any other group (Table 3) but once differences in age, gender and location were accounted for in the statistical model their responses were comparable to all other groups ($p > 0.05$). Farmers gave higher boredom scores than citizens unrelated to agriculture (mean difference = 10.5; SE = 2.8; 95% CI = 2.7 to 18.3; $p < 0.01$).

Main effects of species

There were significant main effects of species on scores for pain, fear and boredom, but not hunger, across all occupations (Tables 3 and 4). Dogs received higher pain scores than cows (mean difference = 6.5; SE = 1.5; 95% CI = 2.6 to 10.4; $p < 0.001$) and pigs (mean difference = 4.2; SE = 1.5; 95% CI = 0.3 to 8.1; $p < 0.05$); higher fear scores than cats (mean difference = 5.1; SE = 1.8; 95% CI = 0.2 to 9.9; $p < 0.05$) and cows (mean difference = 7.1; SE = 1.8;

95% CI = 2.2 to 11.9; $p < 0.01$); and higher boredom scores than cats (mean difference = 10.3; SE = 2.6; 95% CI = 3.4 to 17.2; $p < 0.01$), cows (mean difference = 16.8; SE = 2.6; 95% CI = 9.9 to 23.7; $p < 0.001$) and pigs (mean difference = 7.0; SE = 2.6; 95% CI = 0.1 to 13.9; $p < 0.05$). Pigs received higher boredom scores than cows (mean difference = 9.9; SE = 2.6; 95% CI = 3.0 to 16.8; $p < 0.01$). Cats' boredom scores were comparable to both pigs and cows ($p > 0.05$).

Main effects of age, gender and location

Females gave a higher score than males for pain (mean difference = 3.0; SE = 1.3; 95% CI = 0.4 to 5.6; $p < 0.05$) and boredom (mean difference = 5.5; SE = 2.4; 95% CI = 0.9 to 10.1; $p < 0.05$) but gender did not affect hunger or fear scores (Table 4). There were significant main effects of age on scores for hunger and boredom but not pain or fear (Table 4). These were determined by significant but weak negative correlations between age and hunger score ($r = -0.187$, $p < 0.001$) and age and boredom score ($r = -0.202$, $p < 0.001$); whereby older respondents regarded all species as less capable of experiencing hunger and boredom. Participants located in Ireland scored the capacity for pain to be higher than those located in England (mean difference = 4.4; SE = 1.6; 95% CI = 0.6 to 8.3; $p < 0.05$) and Scotland (mean difference = 5.0; SE = 1.7; 95% CI = 0.8 to 9.2; $p < 0.05$) but location did not affect hunger, fear or boredom scores (Table 4).

Discussion

In order to minimise psychological discomfort, some people who eat meat make ethical buying decisions whilst many mentally disengage *animals* from *meat* (Bastian & Loughnan,

2017; Hoogland et al., 2005; Schröder & McEachern, 2004). When forced to face this link, one resolution is to reduce their perception of animals capacity to suffer (Bastian et al., 2012; Bilewicz et al., 2011; Bratanova et al., 2011; Loughnan et al., 2010; Wilkins et al., 2015) and hence, moral concern for animals. Farmers are unable to avoid the link between animals and meat, and this study provided the first investigation into whether they cope with the adverse effect of the farming system on their animals by ascribing them diminished capacity to suffer. The results did not support our hypothesis that pig farmers ascribe the species diminished mental states necessary to experience suffering.

Test of hypotheses

There were no significant interactions between species and occupations for pain, fear and boredom; indicating that the effect of species on scores for pain, fear and boredom did not depend on occupation. Where a significant interaction did occur (hunger) it did not reside with farmers devaluing pig ratings in comparison to other species (hypothesis 1) and citizens unrelated to agriculture (hypothesis 2). In fact, farmers judged pigs as more capable of experiencing hunger than each of the other species. Sows are feed-restricted for management purposes and express their hunger through vocalizations and (redirected) feeding behaviour (D'Eath et al., 2018). Farmers are therefore daily exposed to sows' chronic hunger (Tolkamp & D'Eath, 2016) and their responses may thus be influenced by knowledge about the animals' capacity to experience hunger. Moreover, their response could be linked to greater empathy because of experience. Exposure and contact are known to enhance empathy between humans (Dovidio, Gaertner, & Kawakami, 2003; Pettigrew & Tropp, 2008) and this has more recently been demonstrated in human-animal relationships (Morris, Knight, & Lesley, 2012). However, it is important to note that the specialised pig veterinarians had comparable years' experience working with pigs but no significant effects were detected for

this group. Nevertheless, veterinarians are not responsible for animal husbandry and their exposure to sow hunger will, therefore, differ to the farmers'. Scientists express widespread belief in the emotional lives of animals, including those that they use in their research (Knight, Vrij, Bard, & Brandon, 2009). Along with the results of the current study, this demonstrates that animal husbandry and the experimental use of animals can still be supported even when animals are perceived to be capable of suffering. Moreover, it fails to support an important prediction from current psychological theory; that farmers will deny their animals more mind.

Effects of occupation on perceptions of animal capacity to suffer

Although all occupations expressed widespread belief in animals' capacity to suffer, there were differences between groups in their attribution of each sensation/emotion. Even after controlling for demographic differences, applied animal science students gave higher scores than farmers, veterinarians, agriculture students and citizens for fear; higher scores than farmers and citizens for pain, and; higher scores than farmers, agriculture students and citizens for hunger. Furthermore, animal science students judged dog capacity for hunger as greater than farmers, cat capacity for hunger greater than farmers and agriculture students and cow and pig capacity for hunger greater than citizens unrelated to agriculture. Farmers were comparable to specialised pig veterinarians, agricultural students and citizens in their scores for hunger, pain and fear, but gave higher boredom scores than citizens unrelated to agriculture. These results are consistent with evidence that stakeholders view animals differently based on their different values, norms, convictions, interests, and knowledge (Te Velde et al., 2002). For example, animal science students are known to hold strong values and interests regarding animal welfare (Heleski & Zanella, 2006) and learn about animal suffering during their course. Capacity to suffer is emphasised as the basis of moral concern

for animals and belief in animal sentience is a strong predictor of attitudes towards animals and their use (Knight et al., 2009; Knight, Vrij, Cherryman, & Nunkoosing, 2004). Therefore, the widespread belief in animal capacity to suffer expressed by our comparison groups is positive, particularly as the student populations are likely to work with animals in either agricultural or scientific contexts in the future, whilst farmers and veterinarians are currently responsible for the welfare of animals under their care.

Effects of species on perceptions of animal capacity to suffer

All species (dogs, cats, cows, and pigs) were judged have the capacity to experience a range of negative sensations and emotions (hunger, pain, fear and boredom). This is consistent with a survey of 200 members of the public which revealed widespread belief in animal sentience across a variety of species (Morris et al., 2012). Nevertheless, our study detected some important differences in the attribution of pain, fear and boredom between species, with dogs receiving the highest scores. There were no differences between species in the attribution of hunger (unless controlling for the effect of occupation, see section above titled 'Test of hypotheses'). Specifically, dogs were believed to be able to experience pain more than cows and pigs; fear more than cats and cows and; boredom more than cats, cows and pigs. This is consistent with a survey of 425 students in which it was found that dogs are perceived as highly sentient, exceeding new born babies, followed by foxes, pigs, chickens, rats and fish (Phillips & McCulloch, 2005). In the current study, pigs were judged as comparable to dogs, cats and cows in their capacity to feel fear. They were comparable to cats and cows in their capacity to feel pain, and comparable to cats, but more capable than cows, of feeling boredom. The attribution of human-like experiences and cognitive abilities to animals is known to be influenced by the degree of attachment to that species, with food-animals attributed diminished capacity to suffer (Bastian et al., 2012; Bratanova et al., 2011; Eddy,

436 Gallup, & Povinelli, 1993; Loughnan et al., 2010; Wilkins et al., 2015). It is, therefore,
437 somewhat surprising that pigs were consistently judged to have similar emotional capabilities
438 to cats, and were judged more capable of feeling boredom than cows. Furthermore, citizens
439 unrelated to agriculture judged pigs as comparable to cats and dogs, and more capable than
440 cows, of experiencing hunger. Davis and Cheeke (1998) carried out a survey of university
441 staff and students in the US and found that non-food animals were judged to be more
442 intelligent than livestock species, with the interesting exception of pigs who were judged to
443 be comparable in intelligence to cats and dogs. The authors suggest that this could be due to
444 the depiction of pigs in popular books and television programs as highly intelligent in
445 comparison to other species produced for food (this has also been noted elsewhere: Arnold,
446 1988). Furthermore, a survey of animal science students found that pigs were judged as more
447 capable of experiencing pain and boredom than cows (Heleski & Zanella, 2006). Therefore,
448 the current study contributes to the evidence that pigs are a livestock species perceived to
449 hold strong mental capacities, and indeed this is supported by studies of pig cognition
450 (Mendl, Held, & Byrne, 2010).
451
452 **Effects of age, gender and location on perceptions of animal capacity to suffer**

453 There were some important demographic differences between our comparison groups. For
454 example, pig farmers were predominantly male and on average exceeded 40 years old, whilst
455 animal science students were predominantly female and on average younger than 25 years
456 old. These demographic differences were unavoidable in order to maintain the
457 representativeness of each population. We controlled for demographic factors in our
458 statistical models, and results confirmed that it was crucial to do so. Female participants
459 judged animal capacity to experience pain and boredom to be greater than males. This is
460 consistent with previous research employing the same survey which found that female

461 veterinary students regarded cats and cows as more likely to feel pain than male students
462 (Paul & Podberscek, 2000). Furthermore, there is consistent evidence that on average,
463 females show higher levels of positive behaviours and attitudes toward animals; for example
464 by expressing greater empathy for animals (Colombo, Crippa, Calderari, & Prato-Previde,
465 2017; Hills, 1993), more opposition to animal use, and greater involvement with animal
466 protection activities (Heleski, Mertig, & Zanella, 2006; Herzog, 2007). Furthermore, we
467 found weak negative correlations which revealed that older participants expressed less belief
468 in animals' capacity to experience hunger and boredom than younger participants. This is
469 inconsistent with a survey of 96 members of the UK public which found that older
470 participants had greater belief in the mental capacities of animals (Knight et al., 2004).
471 Nevertheless, the study of Knight et al (2004) used different terms and subsequent evidence
472 indicates that younger people are most concerned about animal welfare (Vanhonacker,
473 Verbeke, Van Poucke, & Tuyttens, 2007). Participants in Ireland reported higher pain scores
474 than those in England and Scotland although our sample size from the Republic of Ireland
475 was smaller than that from Scotland and England. This implies that there may be cultural
476 differences in perceptions of animal pain, but warrants further investigation.
477
478 **Study limitations and directions for future research**
479 There are several limitations to the current study which are important to highlight here.
480 Regarding the participants sampled, the student populations were limited to one institution,
481 therefore results cannot be generalised to student populations elsewhere. None of our
482 respondents were based in Northern Ireland or Wales; therefore our sample cannot be
483 considered as fully representative of the UK population. Furthermore, the sample of
484 specialised pig veterinarians was small due to difficulties in reaching this specialised
485 demographic, and this could risk Type II errors due to a lack of statistical power. It is also

possible that participants were influenced by experimenter effects whereby they responded in a way that they thought was desired rather than how they actually felt. Nevertheless, we did attempt to control this bias by ensuring that all participants knew that their responses were confidential and could not be tied to any individual. Finally, a primary limitation of the current study was the restricted range of species, sensations and emotions surveyed. A focus on a small number of species, and the emotions and sensations most likely to be directly elicited by common pig husbandry practices, was necessary to achieve a robust sample size of respondents.

Therefore, the limited survey and study design employed here provides only an initial exploration into this subject area. The extensive research into strategies employed by human-omnivores to reduce cognitive dissonance provides several directions for future research. First, future research should build upon these findings by including a greater range of species and capacities, including higher order traits, such as intelligence and secondary emotions, as employed in prior research into omnivores (Bastian et al., 2012; Bilewicz et al., 2011; Morris et al., 2012). Second, human omnivores display flexibility in their perceptions of animal sentience depending on recent behaviour (Loughnan et al., 2010), and this suggests that farmer responses to the current survey may have been influenced by recent behaviour. All farmers participated at farmer discussion groups, rather than on the farm or whilst working with pigs. Repeating the current study whilst experimentally manipulating the timing of farmer participation, e.g., during painful husbandry tasks such as tail docking and tagging, at weaning, and at slaughter, may reveal that their perceptions of pig capacity to suffer change when being directly confronted with animal suffering. This could be developed further by including measures of farmer discomfort with such procedures as a potential mediator of any reductions in mind attribution. Third, human omnivores rationalise meat-eating by endorsing

positive beliefs about meat that fit with their dietary practices. They defend eating meat as necessary (for health), natural, normal and nice (the 4Ns: Piazza et al., 2015). Participants that endorsed the 4Ns tended to attribute fewer mental capacities to cows, included fewer animals in their circle of moral concern, consumed more animal products, were not motivated by ethical concerns in their buying decisions and experienced less guilt about their animal-product decisions (Piazza et al., 2015). Piazza et al. (2015) concluded that the 4Ns are a powerful, pervasive tool employed by individuals to reduce cognitive dissonance, but to date the use of the 4Ns has never been investigated in farmers. Fourth, human omnivores adjust perceptions of personal responsibility by placing the blame with other stakeholders such as retailers and the government (Bastian & Loughnan, 2017; Schröder & McEachern, 2004) and some evidence suggests that farmers employ this strategy (Te Velde et al., 2002). This may be particularly relevant if farmers feel constrained in their ability to improve welfare due to small profit margins. Finally, human omnivores emphasise 'responsible' behaviour, for example by under-reporting how frequently they eat meat, limiting their meat intake, or only eating certain types of meat (Bastian & Loughnan, 2017; Rothgerber, 2014, 2015a, 2015b) and it is possible that farmers employ an equivalent strategy by emphasising responsible behaviour on their farm. The strategy employed to reduce dissonance is likely to depend on a range of contextual factors, and when one fails another will take hold (Bastian & Loughnan, 2017).

Therefore, psychological defenses employed by omnivores to resolve dissonance have been widely researched and have important implications for animal consumption, but no research has investigated how these additional psychological defences are employed during the meat production process itself. Farmers are directly responsible for the welfare of their animals and the psychological and behavioural strategies that they employ may have important

implications for their motivation to improve animal welfare. This is, therefore, an important area of future research.

Conclusions

We found that pig farmers ascribed pigs with similar capacities to suffer as cows, dogs and cats and showed similar outcomes to agricultural students, animal science students, pig veterinarians and citizens unrelated to agriculture. This study provides a first investigation into cognitive dissonance related to the 'meat paradox' in farmers. Cognitive dissonance mechanisms may be at play in farmers and this may affect their incentives to improve farm animal welfare and, as such, deserves further investigation.

Acknowledgements

The authors are grateful to those who participated in this study. We thank the staff at Teagasc, Scotland's Rural College and AHDB Pork for help in the recruitment of farmers. We thank Professor Eddie Clutton for making helpful comments on the manuscript. This study was funded by SRUC. SRUC receives financial support from the Scottish Government Strategic Research Portfolio.

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727 **Tables**

728 Table 1. Participants' age, gender and experience of working with pigs according to their
729 occupation and role on farm.

Occupation	Role on farm	Mean years' experience (SD, range)	Mean age in years (SD, range)	Female	Male
Farmer (n=76)	Owner (n=25)	27.4 (9.9, 10-45)	47.2 (8.8, 30-61)	2.6% (n=2)	30.3 % (n=23)
	Manager (n=12)	26.4 (13.0, 1-50)	50.2 (11.4, 28-68)	1.3% (n=1)	14.5% (n=11)
	Contract (n=7)	22.4 (13.0, 5-40)	43.4 (17.6, 18-64)	0% (n=0)	9.2% (n=7)
	Worker (n=30)	6.7 (8.0, 1-42)	33.2 (10.3, 18-55)	4.0% (n=3)	35.5% (n=27)
	Retired (n=2)	52.5 (17.7, 40-65)	81.5 (0.7, 81-82)	0% (n=0)	2.6% (n=2)
	All roles	*19.5 (15.0, 1-65)*	42.7 (14.2, 18-82)	7.9% (n=6)	92.1% (n=70)
Specialised pig veterinarian (n=15)	-	14.3 (15.0, 0.75– 40)	41.3 (14.6, 25-66)	66.7% (n=10)	33.3% (n=5)
Applied animal science student (n=22)	-	-	23.1 (3.0, 22-36)	81.8% (n=18)	18.2% (n=4)
Agriculture student (n=23)	-	-	22.4 (1.7, 21-29)	47.8% (n=11)	52.2% (n=12)
Citizens unrelated to agriculture (n=58)	-	-	52.0 (16.8, 19-88)	70.7% (n=41)	29.3% (n=17)

730 Table 2. Mean number of pigs kept at each stage of production at any one time, range and
731 standard deviation (SD). The number of farmers that kept pigs at the specified stage of
732 production is given in parentheses.

733

Stage of production	Mean (n)	Range	SD
Weaners	1918.0 (51)	150-10000	1857.0
Growers	2493.5 (42)	150-30000	4739.0
Finishers	3429.7 (48)	100-38000	5914.0
Sows	1164.2 (66)	40-13500	2297.9

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738 Table 3. Mean (standard deviation) hunger, pain, fear and boredom scores according to
739 occupation and species. All scores were measured on a 100mm visual analogue scale.

Emotion/ sensation	Occupation	Species				
		Dogs	Cats	Pigs	Cows	All species
Hunger	Farmers	83.5 (15.7)	82.4 (17.0)	88.9 (9.9)	84.9 (15.3)	85.0 (14.8)
	Specialised pig veterinarians	89.7 (12.3)	86.3 (14.4)	87.5 (14.3)	82.8 (18.7)	87.3 (14.7)
	Applied animal science students	95.0 (5.3)	94.7 (5.8)	94.3 (5.5)	94.5 (6.2)	94.6 (5.6)
	Agriculture students	85.7 (18.0)	80.3 (23.0)	88.1 (11.0)	88.1 (10.5)	85.6 (16.5)
	Citizens unrelated to agriculture	88.0 (15.5)	85.6 (13.6)	82.9 (19.4)	76.9 (23.9)	83.5 (18.7)
	All occupations	86.9 (15.2)	84.8 (16.2)	87.5 (13.9)	83.8 (18.2)	85.8 (15.9)
Pain	Farmers	87.8 (10.7)	84.6 (14.5)	86.3 (17.2)	81.3 (17.6)	85.1 (15.3)
	Specialised pig veterinarians	90.9 (10.5)	87.3 (15.1)	86.5 (14.4)	83.8 (18.0)	87.8 (14.4)
	Applied animal science students	95.3 (5.1)	94.5 (5.6)	92.7 (6.1)	92.4 (8.3)	93.7 (6.4)
	Agriculture students	87.8 (10.9)	86.1 (15.8)	86.9 (12.3)	87.8 (12.0)	87.2 (12.7)
	Citizens unrelated to agriculture	91.4 (8.1)	87.6 (13.2)	81.9 (19.7)	81.0 (21.0)	85.5 (16.6)
	All occupations	90.0 (9.7)	87.0 (13.8)	85.8 (16.6)	83.5 (17.7)	86.6 (14.9)
Fear	Farmers	86.2 (13.4)	80.6 (19.6)	84.7 (17.5)	78.7 (21.2)	82.6 (18.2)
	Specialised pig veterinarians	87.7 (13.1)	85.7 (15.0)	82.9 (18.2)	81.7 (19.3)	84.8 (16.2)
	Applied animal science students	94.0 (6.8)	93.3 (6.4)	92.5 (5.7)	92.3 (7.8)	93.0 (6.6)
	Agriculture students	86.0 (12.9)	83.0 (17.8)	84.4 (18.9)	85.7 (14.1)	84.8 (15.9)
	Citizens unrelated to agriculture	87.1 (14.9)	79.5 (23.4)	76.6 (22.5)	75.6 (24.4)	79.9 (21.7)
	All occupations	87.4 (13.3)	82.4 (19.6)	83.0 (19.0)	80.4 (20.8)	83.4 (18.4)
Boredom	Farmers	77.5 (21.9)	69.6 (26.6)	78.8 (24.4)	64.0 (29.6)	72.7 (26.2)
	Specialised pig veterinarians	85.1 (18.6)	69.6 (30.9)	80.5 (19.1)	58.3 (27.5)	74.2 (25.7)
	Applied animal science students	88.7 (13.9)	78.0 (26.4)	80.5 (21.3)	73.5 (24.3)	80.2 (22.3)
	Agriculture students	79.1 (22.6)	70.6 (28.9)	77.3 (24.9)	70.9 (28.4)	74.5 (26.2)
	Citizens unrelated to agriculture	77.1 (22.6)	64.5 (28.9)	57.0 (28.3)	54.3 (29.6)	62.9 (28.7)
	All occupations	79.4 (21.4)	69.1 (27.9)	72.4 (26.8)	62.6 (29.3)	70.9 (27.1)

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Table 4. Results of four residual maximum likelihood (REML) models investigating the effects of age, gender, species and occupation on scores for: 1) hunger 2) pain 3) fear, and 4) boredom. Non-significant effects and interactions were removed from each model and the model re-run until the simplest model was achieved.

Dependent variables	Independent variables					
	Main effects					Interaction
	Gender	Age	Location	Species	Occupation	Species x Occupation
Hunger score	NS	F= 11.638**	NS	NS	F= 4.525**	F= 1.850*
Pain score	F= 4.983*	NS	F= 4.883**	F= 5.797***	F= 4.611**	NS
Fear score	NS	NS	NS	F= 5.281**	F= 9.235***	NS
Boredom score	F= 5.467*	F= 11.824**	NS	F= 14.416***	F= 4.311**	NS

* $p<0.05$, ** $p<0.01$ *** $p<0.001$