

Scotland's Rural College

Farmers' perception of aggression between growing pigs

Camerlink, I; Turner, SP

Published in:
Applied Animal Behaviour Science

DOI:
[10.1016/j.applanim.2016.11.009](https://doi.org/10.1016/j.applanim.2016.11.009)

First published: 19/11/2016

Document Version
Peer reviewed version

[Link to publication](#)

Citation for published version (APA):
Camerlink, I., & Turner, SP. (2016). Farmers' perception of aggression between growing pigs. *Applied Animal Behaviour Science*, 192, 42 - 47. Advance online publication. <https://doi.org/10.1016/j.applanim.2016.11.009>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Accepted Manuscript

Title: Farmers' perception of aggression between growing pigs

Author: Irene Camerlink Simon P. Turner

PII: S0168-1591(16)30342-2

DOI: <http://dx.doi.org/doi:10.1016/j.applanim.2016.11.009>

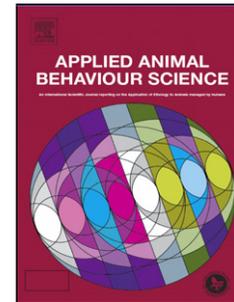
Reference: APPLAN 4364

To appear in: *APPLAN*

Received date: 27-4-2016

Revised date: 8-11-2016

Accepted date: 16-11-2016



Please cite this article as: Camerlink, Irene, Turner, Simon P., Farmers' perception of aggression between growing pigs. *Applied Animal Behaviour Science* <http://dx.doi.org/10.1016/j.applanim.2016.11.009>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Title page

Farmers' perception of aggression between growing pigs

Irene Camerlink* & Simon P. Turner

Animal Behaviour & Welfare, Animal and Veterinary Sciences Research Group, Scotland's Rural
College (SRUC), West Mains Rd., Edinburgh, EH9 3JG, UK

*Corresponding author. I. Camerlink. Irene.Camerlink@sruc.ac.uk; tel. +44 (0)131 6519363

Correspondence address: Irene Camerlink, SRUC, Roslin Institute Building, Easter Bush, Midlothian,
EH15 9RG; Irene.Camerlink@sruc.ac.uk

Highlights

- Pig farmers were asked about their perception on pig aggression and management
- Most farmers did not regard aggression as a problem that needed to be addressed
- A method to reduce aggression raised concerns despite being widely applied
- Current research is not well aligned with farmers' perception on welfare causes
- A sustainable approach to pig husbandry should integrate all parties involved

Abstract

Sustainable animal production should take animal welfare into account. How animal welfare is incorporated into farming practices will, however, largely depend on the farmer's choices. These choices may depend on the farmer's perception of animal welfare and the willingness to change the current situation. Aggression between group housed pigs is a longstanding welfare issue and research efforts have resulted in little to no change in practice. Our objective was to gain insight into farmers' perception of aggression between growing pigs and their opinion about a method shown by research to reduce the expression of this behaviour. Pig farmers in the UK were asked about their management and perception regarding aggression through a postal survey. Respondents ($n=167$) had a breeder-to-finisher farm ($n=114$; 585 ± 123 sows; range 0-7000), breeder-weaner farm ($n=10$; 718 ± 433 sows; range 15-45000), or grower/finisher farm ($n=32$; 1291 ± 187 grower/finishers; range 24-5000). The majority of the respondents did not consider aggression at mixing as a problem which needed to be addressed (73% at weaning). For mixing at the finisher stage, 43% did consider aggression a problem and indicated they would consider a solution if available. Farmers who considered aggression at the grower/finisher facilities a problem were on average younger (55 ± 12 years) than farmers who did not consider it a problem (61 ± 12 years; $P=0.02$). When respondents ranked welfare issues on what they found most important to reduce at the grower/finisher phase, they ranked tail/ear/flank biting as more important than mounting and lameness, but not different from aggression. Currently, 27% of the pig breeders (respondents keeping sows) applied co-mingling of piglets (i.e. 'socialization'), in which piglets are pre-weaning introduced to piglets of other litters to reduce aggression later on, and 22%

had worked with such a strategy in the past. Farmers applying co-mingling did not differ in their perception of aggression compared to farmers who did not co-mingle. Respondents expressed concerns about co-mingling with regard to practical management (48%), aggression of the sow towards piglets (33%), reduced piglet growth rate (24%), fights between piglets (22%), cross-suckling (20%), missed suckling bouts (16%), and stress for the animals (16%). Half of the breeders were in favour of co-mingling (51%) whereas the other half was against (49%). As part of a sustainable approach integrating all stakeholders, knowledge of farmers' perception of aggression may help align research questions in this area with the concerns of the stakeholders.

Keywords. Survey, farmers, pig, aggression, perception

1. Introduction

Animal welfare is considered as an integral part of sustainable agriculture (e.g. Keeling, 2005; Broom, 2010). Sustainability is based on the key pillars of economic viability, environmental footprint, and societal acceptance. Society's growing demand for animal welfare standards for food products has made animal welfare an undeniable component within the societal component of sustainability. Key aspects of sustainability may be enforced through regulation but these vary greatly between countries and enforcement may take years before a change in practice is visible. More rapid progress towards sustainability may arise due to entrepreneurs' initiatives to adopt sustainable practices (Nicholls, 2006). This is especially true for animal welfare (Bock & van Huik, 2007), which largely depends on farmers' willingness or incentives to improve farm practices (de Lauwere et al., 2012) or their human-animal interaction (Kauppinen et al., 2012; Verdon et al., 2015). The willingness to change current practices will depend upon the perception of the situation (Bock & van Huik, 2007; de Lauwere et al., 2012) and therefore farmers' perception about animal welfare is crucial for an improvement in animal welfare to happen in practice.

Aggression between pigs is one issue in which multiple pillars of sustainability may be affected. Aggression between group housed pigs in commercial pig husbandry has been a long standing animal welfare issue (e.g. Marchant-Forde & Marchant-Forde, 2005). It has been researched for several

decades but has resulted in little to no change to animal welfare in practice. Agonistic behaviour occurs when unfamiliar pigs try to settle a new dominance hierarchy. In commercial husbandry pigs are regrouped several times during the production cycle to optimize the use of buildings and to create homogeneous groups that will market simultaneously. This leads to intense fights which cause skin lesions, reduced growth (Tan et al., 1991) and a suppressed immune response (de Groot et al., 2001). The effects on productivity may consequently reduce the environmental and economic sustainability of the production system (Velarde et al., 2015). Although several solutions have been proposed (reviewed by Marchant-Forde & Marchant-Forde, 2005; with in addition the potential of breeding strategies, Turner et al., 2010), aggression has not been reduced in practice. Reasons for this might be that most methods require investments in buildings or labour, the lack of insight into the economic costs of aggression, and that farmers may be desensitized to the effects of common husbandry procedures such as regrouping (Fox, 1984; Wilson et al., 2014).

Due to the routine occurrence of aggression we hypothesized that farmers do not see aggression or its consequences as a welfare problem, or have no incentive to change the situation. Pig farmers have been surveyed for their perception on animal welfare (e.g. Bock & van Huik, 2007; de Lauwere et al., 2012) but not with regard to aggression. The lack of knowledge on farmers' perception of aggression as a welfare issue is a barrier that prevents research from being implemented in practice to effectively reduce aggression between pigs.

We surveyed pig farmers for their perception of aggression. In addition, we asked them about co-mingling of piglets pre-weaning, also called 'socialization', which is at present the most promising and most researched management solution to reduce aggression (Wattanakul et al., 1997; D'Eath, 2005; Hessel et al., 2006; Kutzer et al., 2009; Ledergerber et al., 2015). With co-mingling, piglets of two or more litters are joined together sometime during the lactation phase and remain together up to weaning. This may enhance piglets' social skills, without the disadvantage of severe injuries or production losses, and has been shown to lead to more decisive and less prolonged aggression (D'Eath, 2005). In this study we investigate farmers' perception of aggression between growing pigs and how they view the co-mingling of piglets pre-weaning as management method to reduce aggression.

2. Methods

2.1. Survey and target group

To reach a large number of farmers we chose a postal survey. Previous studies and data from industry indicate that farmers show a low response rate in internet based or e-mail surveys and that personal contact or post is preferred (Ten Alps Publishing, personal communication; e.g. Ison & Rutherford, 2014). Postal addresses were obtained from the database of Ten Alps Publishing, which meant that the farmers had or had had a subscription to a farmers' magazine. The database contained 1,138 addresses of pig farmers throughout the United Kingdom, with an equal distribution of farm sizes across counties. This database represented approximately 10% of the total number of farms registered in the UK census as keeping pigs. Surveys were sent out on the 24th of July 2015 and were received up to 2.5 months after sending. The survey comprised of 13 mainly multiple choice questions which were divided into three sections. The first section listed three questions about the farm (farm type, size, organic). The second section contained nine questions of which three were about aggression between pigs (management of mixing pigs, whether aggression was considered a problem, and a ranking comparing aggression with other relevant welfare issues), five were about co-mingling of piglets before weaning (experience, concerns and management choices), and the last was a box for comments. The third section was about the respondent (gender, age, working experience). The full survey is included in the supplementary files (S1). The survey was colour printed on double-sided A4 and was accompanied by a letter and a pre-stamped return envelope.

2.2. Data preparation

The comments made by respondents in the comment box were assessed for clear incontestable statements, such as "aggression is not a problem". These could be clustered into 1) causes of aggression; 2) comments on whether aggression was a problem; and 3) valence about co-mingling (for example: "It [co-mingling] was very successful as the aggression shown at 3 wk old was just as often but its effect and damage were lessened and short lived"). Causes of aggression were coded for

similar words that were reoccurring throughout the responses. If the text contained the word ‘genetics’ or ‘breed’ in relation to aggression then this was categorized as ‘genetics’. If text contained ‘feed’, ‘feeding’, ‘nutrition’ or ‘diet’ then this was categorized as ‘nutrition’. The words ‘environment’, ‘housing’, ‘straw’, ‘dirt’, ‘weather’ or ‘buildings’ were categorized as ‘environment’.

2.3. Data analyses

Data were analysed in SAS version 9.3 (SAS Institute Inc., USA). Farms were either classified as breeder-to-finisher, breeder-weaner, or grower-finisher, based on their response to which type of farm they had. Questions that applied to all farm types were analysed with the full data set (n = 167 respondents) and questions that related to the co-mingling of piglets pre-weaning were only analysed for the subset of breeder-weaner and breeder-to-finisher farms, together termed as ‘breeders’ (n = 124 breeders). The models are given below, whereby farm type was included as a fixed effect where it was a variable of interest and was included as a random effect in the remaining models (underlined when random) to correct for differences due to farm type.

Question 4, whether respondents regrouped pigs or not, was analysed in a generalized linear mixed model (GLIMMIX) with a binary distribution and logit link function using the following model:

$$(a) \text{ Response Q4 (yes / no) = number of sows + number of finishers + } \underline{\text{farm type}} + e$$

Question 5, whether respondents perceived aggression as a problem that needed to be addressed or not (responses for a and b summed), was analysed in a logistic model (LOGISTIC Procedure) using the models:

$$(b) \text{ Response Q5 for weaning (yes / no) = age + gender + farm type + number of sows + comment about co-mingling (positive / negative / neutral / no comment) + } e$$

$$(c) \text{ Response Q5 for finisher (yes / no) = age + gender + farm type + number of finishers + } e$$

Question 6 involved ranking four issues in order of their priority, ranging from 1 – 4. Differences between how the four issues were ranked relative to each other were analysed in a GLIMMIX with a

multinomial distribution and cumulative logit link function and farm type as random factor, using the model:

$$(d) \text{ Issue A (ranked 1 – 4) = issue B (1 – 4) + issue C (1 – 4) + issue D (1 – 4) + farm type} + e$$

In question 7 respondents indicated whether they co-mingled piglets or not. Differences in perception of aggression (question 5) between breeders who did or did not co-mingle piglets were analysed in a logistic model (LOGISTIC Procedure):

$$(e) \text{ Response Q7 (co-mingling yes / no) = Q5 weaning (yes / no) + Q5 finisher (yes / no) + } e$$

Question 9 identified the number of concerns around co-mingling and was analysed using a general linear model (GLM; model f). The residuals of this response variable were normally distributed as assessed through Shapiro-Wilk statistics.

$$(f) \text{ Response Q9 (number of concerns) = Q7 (co-mingling currently applied / not applied) + number of sows + farm type (breeder-to-finisher / breeder-weaner) + } e$$

Data are presented as least square means with standard errors.

3. Results

3.1. Respondents and their farm

A total of 167 surveys were completed or partially completed, resulting in a response rate of 14.7%. Respondents were mostly males (91 %) of on average 58 ± 1 year old, with 36 ± 1 year of working experience with pigs. Three farm types described 93% of the farms. These were breeder-to-finisher (68%; n = 114); grower-to-finisher farms (19%; n = 32); and breeder-weaner farms (6%; n = 10). The remaining 7% ('other'; n = 11) were hobby farmers and ex-farmers who rented out their pig farm to tenants (so called Bed & Breakfast farms). Farm size, based on the number of animals in the various animal categories, ranged from small to large scale (Table 1). Five farmers had ceased farming but responded to the survey based on their experience, explaining some farms with no animal numbers.

Six farms were certified organic (4%). All respondents ($n = 167$) answered the question about when they mixed pigs, i.e. when the group composition at their farm changed. On average, pigs were mixed 1.3 ± 0.1 times, irrespective of the farm type, with a maximum of 4 times at breeder-to-finisher farms (pigs kept from birth till slaughter; Table 2). Twenty-five farms, of different farm types, never mixed pigs (15%; Table 2). These farms did not differ with respect to the number of sows (632 ± 124 and 223 ± 402 sows for breeders applying mixing and breeders not applying mixing, respectively; $F_{(1,107)} = 2.30$; $P = 0.13$). Nor did these farms differ with respect to the number of grower finishers (1284 ± 231 and 1305 ± 335 pigs for grower-finisher farms applying mixing and for grower-finisher farms not applying mixing, respectively; $F_{(1,107)} = 1.81$; $P = 0.18$).

3.2. Farmers' perception of aggression

The majority of respondents did not perceive aggression between unfamiliar pigs as a problem that needed to be addressed. For aggression at weaning, 73% ($n = 83$) of the total number of respondents did not see aggression as a problem that needed to be addressed, and for aggression at mixing into the grower/finisher facilities this was 57% ($n = 68$). Gender and age did not affect the perception of aggression at weaning (gender $P = 0.16$; age $P = 0.72$) and gender did not affect the perception of aggression at the grow-finisher period ($P = 0.73$). However, for the grower-finisher phase respondents who considered aggression a problem were on average younger (55 ± 12 years old) than respondents who did not consider aggression a problem (61 ± 12 years old; $\chi^2 = 5.67$; $P = 0.02$, $df = 1$). Whether respondents perceived aggression as a problem that needed to be addressed at weaning or not, did not depend on farm type ($\chi^2 = 0.89$; $P = 0.83$, $df = 3$) or the number of sows they had ($\chi^2 = 0.41$; $P = 0.52$, $df = 1$). The perception of aggression at the grow-finisher stage also did not depend on farm type ($\chi^2 = 1.58$; $P = 0.66$, $df = 3$) or on the number of grower-finishers ($\chi^2 = 0.60$; $P = 0.44$, $df = 1$).

Respondents who did view aggression between unfamiliar pigs as a problem ($n = 30$ for weaning; $n = 50$ for grower/finisher) varied in their willingness to change the situation. If solutions to reduce aggression between pigs were available, 20% ($n = 23$) of the respondents would consider adopting these methods to manage aggression at weaning and 37% ($n = 43$) would do so at the grower/finisher stage. The remaining 6% ($n = 7$) indicated that they perceived aggression as a problem but would not invest in a solution or change management in order to reduce aggression, either at weaning or at the grower/finisher phase.

Respondents were asked to rank aggression, lameness, tail/ ear/ flank biting, and mounting behaviour from 1 to 4 based on what they found most important to reduce at the grower/finisher phase, with 1 being most important. This question was only partially completed by some respondents, but 130 respondents entered at least one number to indicate a rank. The order in which respondents ranked these issues for the grower/finisher stage was tail/ear/flank biting (1), mounting (2), aggression (3), and lameness (4) (Figure 1). ‘Tail/ear/flank biting’ was ranked as significantly more important to reduce than mounting ($F_{(3,104)} = 11.4$; $P < 0.001$) and lameness ($F_{(3,104)} = 3.2$; $P = 0.03$), but did not differ from the ranking of aggression ($F_{(3,104)} = 1.6$; $P = 0.21$). Aggression was not ranked differently from tail/ear/flank biting, lameness ($F_{(3,104)} = 1.9$; $P = 0.14$) or mounting ($F_{(3,104)} = 1.1$; $P = 0.35$) and the rank for lameness did not differ from the rank of mounting ($F_{(3,104)} = 2.0$; $P = 0.11$). Farm type did not influence the ranking of these issues ($P > 0.05$).

3.3. Farmers’ perception of co-mingling piglets before weaning

Co-mingling piglets prior to weaning was applied at 27% ($n = 45$) of the farms, either intentionally through management or unintentionally in outdoor systems that allows piglets to co-mingle. These were 38 (33%) of the breeder-to-finisher farms, 4 (40%) breeder-weaner farms, and 3 (27%) ‘other’ farms. In addition, 37 (22%) respondents, of which 7 were grower-finisher farmers, had worked with a system in the past in which piglets were co-mingled prior to weaning. For the breeding farms, 16% ($n = 19$) of respondents did not work with such a system as they believed that it had many disadvantages, another 35% ($n = 41$) indicated that it was not feasible at their farm, and 7% ($n = 8$) were unfamiliar with the concept of co-mingling.

Breeders who applied co-mingling did not differ in their perception of aggression at the weaning phase ($\chi^2 = 2.49$; $P = 0.29$, $df = 2$) or grower/finisher phase compared to breeders who did not co-mingle ($\chi^2 = 4.69$; $P = 0.10$, $df = 2$). From the breeders who indicated that they currently applied a system involving co-mingling of piglets, 54% ($n = 17$) perceived aggression at the grower/finisher stage as a problem and 14 out of 17 would consider solutions if available. From the breeders who did not apply co-mingling 32% ($n = 22$) perceived aggression as a problem, and 18 out of 22 indicated they would consider solutions if available.

Respondents were asked if they would implement co-mingling of piglets pre-weaning if it would considerably reduce aggression between pigs. This was analysed only for breeders, i.e. for the farms in which such a change would be relevant. One quarter of the 103 respondents ($n = 25$; 25%) was in favour of implementing co-mingling and a further quarter ($n = 27$; 26%) was in favour if it positively affected production (Table 3). The remaining half would not implement co-mingling. Respondents could then choose multiple reasons to explain their reluctance to co-mingle litters (Table 4). The number of concerns expressed by breeders about co-mingling piglets pre-weaning was lower in farms that currently applied co-mingling (co-mingling 1.1 ± 0.4 concerns; no co-mingling 2.7 ± 0.3 concerns; $F_{(1,114)} = 22.63$; $P < 0.001$). The number of concerns tended to be higher at farms with a greater number of sows ($b = 0.0002 \pm 0.0$ concerns / sow; $F_{(1,114)} = 3.63$; $P = 0.06$) but was unrelated to the type of breeder farm (breeder-weaner 1.7 ± 0.5 concerns; breeder-to-grower 2.1 ± 0.2 concerns; $F_{(1,114)} = 0.50$; $P = 0.48$).

Respondents (all responses considered, irrespective of current farm type) were asked to specify how many litters they would co-mingle together into a single social group if they were forced to do so. Half (51%) of the 114 farmers who responded to this question would co-mingle 2 litters together with smaller percentages for larger numbers of litters (3 litters, 9%; 4 litters, 6%; 5 litters, 6% and >5 litters, 23%). Five farmers ticked multiple options. If respondents were to co-mingle pigs prior to weaning, they preferred to do so either in the second week after farrowing, with piglets being 8 to 14 days old (35%; $n = 43$), or in the third week after farrowing with piglets being 15 to 21 days old (30%; $n = 37$). Less preferred ages were the first (10%; $n = 12$) and fourth week of life (13%; $n = 16$), and within 2-3 days of weaning (13%; $n = 16$).

3.4. Comments from farmers

Additional comments were provided by 78 farmers (47%). Nineteen farmers specifically mentioned that aggression was not a problem at their farm. However, three farmers mentioned that they had experienced that pigs in stable groups in the grower/finisher phase fought till death. Fourteen farmers who had experience with co-mingling systems mentioned as disadvantages crushing of piglets (also termed overlaying), cross-suckling, and additional work load and costs. Seven farmers were positive

about co-mingling and mentioned that it reduced aggression. Comments indicating positive or negative valence about co-mingling did not affect the perception of those respondents on aggression (Question 5; $P > 0.05$). Farmers specifically highlighted genetics ($n = 8$), nutrition ($n = 3$), and the environment ($n = 6$) as causes of aggression. From three responses it became apparent that farmers interpreted tail biting as aggression (mention of tail biting when explaining causes of and solutions to aggression).

4. Discussion

Progress in improving animal welfare will largely depend on the willingness of farmers to adopt changes, which in turn will depend upon their perception of animal welfare. The current survey retrieved responses of 167 pig farmers across the United Kingdom on pig aggression and on co-mingling of piglets pre-weaning (i.e. ‘socialization’), which is a method in which piglets are grouped with piglets of another litter (by removing the partition between crates) to reduce aggression at a later stage.

4.1. Sample population

The respondents were representative of the UK population of farmers, in which 85% is men and the median age is 59 years (Defra, 2014, 2015). The sample population showed a large variation in farm size (the number of animals), with the average size in number of sows reflecting commercial holdings (53% of the UK breeding farms has between 250 – 749 sows; AHDB, 2015). Farm size did not affect the responses, suggesting that aggression is perceived similarly irrespective of farm size. Responses may have depended on the job position of the respondent, e.g. farm manager or stock worker (as suggested by Spooner et al., 2014). Although this information was not available, 85% of the farm holders in the UK are also the farm manager and only 3% of the farms are managed by a person unrelated to the holder’s family (Defra, 2015). This makes it less likely that job position of the respondent will have affected responses in the present study. Approximately 40% of the respondents

currently co-mingled piglets or had done so in the past, which may be partly attributed to the fact that roughly 40% of the UK pig production is outdoor in which piglets from different litters most often are allowed to co-mingle.

4.2. Farmers' perception of aggression between pigs

Aggression between unfamiliar pigs is common in commercial pig husbandry and has been, and still is, a major animal welfare issue (Marchant-Forde & Marchant-Forde, 2005; Hemsworth et al., 2015). The current survey suggests, however, that the majority of the UK pig farmers do not see aggression between pigs as a problem that needs to be addressed.

One reason that may explain this result is farmers' perception of animal welfare in general. Previous studies have shown that farmers, including pig farmers, are less concerned about animal welfare issues than urban citizens (Te Velde et al., 2002; Vanhonacker et al., 2008). This may be similar for aggression between pigs as an animal welfare problem. Aggression between unacquainted growing pigs is common during the routine practice of regrouping pigs. Skin lesions due to fighting are generally superficial and do not require treatment, certainly at weaning when skin lesions are less severe than at the grow-finisher stage. In growing pigs, injuries beyond skin lesions, such as lameness, seldom occur. As a result, farmers may have become desensitized to aggression and to its consequences for the animal (Fox, 1984; Wilson et al., 2014).

A second reason why farmers might not consider aggression to be important to reduce may be because of the many challenges that compete for farmers' attention, as well as limited financial resources. Pigs in commercial husbandry face many health and welfare threats at various stages during the production cycle. Issues which have a relatively minor impact on production, such as aggression, may therefore be of lower concern. In the ranking of welfare issues 'tail/ear/flank biting' was considered most important. Tail biting may lead to considerable production losses (D'Eath et al., 2015). The costs due to tail biting as well as potential solutions and their costs have been well documented (D'Eath et al., 2015). On the contrary, the consequences of aggression and the potential

solutions have, to our knowledge, never been translated into financial costs, which may contribute to its low prioritization. Farmers were surveyed for their perception of aggression and we have not measured the actual on-farm level of aggression. Farmers may have responded based on the occurrence of aggression at their farm or either on their perception of aggression in general.

Additional farmers' comments indicated that some respondents refer to tail biting when asked about aggression. Aggression and tail biting may be used by farmers as interchangeable terms which has been pointed out previously (Bracke et al., 2013; Benard et al., 2014). Aggression and tail biting have however different causes; aggression mainly relates to the establishment and maintenance of dominance relationships (McGlone, 1986) whereas tail biting largely originates from a lack of suitable substrate to root, manipulate or chew on (Taylor et al., 2010). Although aggression may be one aetiology of tail biting (Taylor et al., 2010) aggression and tail biting generally require different solutions to reduce their occurrence. Failure to distinguish these behaviours may result in misinterpretation of people's responses and their perceptions. The absence of definitions in the current survey may have led to some misinterpretation of the term 'aggression', although the majority of the comments refer to the correct understanding.

4.3. Co-mingling as a method to reduce aggression

Breeders who currently applied co-mingling did not differ from other breeders in whether they regarded aggression as a problem that needed to be addressed. The survey did however not allow differentiation between farmers who had consciously chosen to apply co-mingling between piglets as a strategy to increase piglets' social skills or farmers who co-mingled piglets as an artefact of their sow housing system, e.g. a multi-suckling or outdoor system which allows piglets to co-mingle.

The preferred strategy for co-mingling piglets was to perform this in the second week of life by mingling two litters together. This approach is in line with the strategy used in empirical studies (e.g. Morgan et al., 2014) which is based on the timing observed in nature (Jensen & Redbo, 1987). Respondents indicated multiple concerns around co-mingling, but fewest concerns were raised by

those currently using a co-mingling system. Research evidence suggests that some of these concerns are not justified. For example, farmers were concerned about cross-suckling of piglets but the majority of studies on co-mingling report either no or limited occurrence of cross-suckling (Wattanakul et al., 1997; D'Eath, 2005; Hessel et al., 2006; Morgan et al., 2014) with the exception of Maletínská and Špinka (2001) who studied multi-suckling groups.

The fact that most of the farmers raised multiple concerns suggests that there is a mismatch between research outcomes and experience from practice, or a failure to communicate experimental findings to industry. The lack of communication between science and the pig husbandry has recently been emphasized by Alarcon et al. (2014) as well. However, research outcomes may generally be more favourable than can be replicated commercially due to heightened care and surveillance of research animals, farm effects, and the reduced production pressure placed on research animals. This emphasizes the importance of testing research methods under commercial conditions before recommendations are given to practice.

4.4. The interplay between ethology and social science in relation to animal welfare

Applied ethology has contributed considerably to our understanding of animal welfare (Millman et al., 2004). However, scientific recommendations are only seldom and slowly adopted by farmers and the subsequent welfare improvement reaches only part of the industry, which poorly reflects the scientific progress made in animal welfare research (Millman et al., 2004). Aggression between pigs as an applied animal welfare problem is one example of this and the current study only briefly touches upon the potential mismatch between scientific objectives and farmers' interests.

Animal welfare research has potential to contribute more to sustainability by improving animal welfare and making animal production more acceptable to society. Society, however, generally perceives animal welfare as more problematic than farmers (Vanhonacker et al., 2008) and farmers in turn may differ in their perception about animal welfare when compared to scientists (Benard et al., 2014). Interdisciplinary research including applied ethology and social sciences, as well as multi-

stakeholder projects, seem essential to the progress of animal welfare in practice (McGlone, 2001; Lund et al., 2006; Benard et al., 2014). Stakeholder perceptions have in recent years been extensively researched and the vast amount of literature on this topic in relation to animal welfare points out the major role that social sciences can play in the study of animal welfare.

5. Conclusion

Aggression at weaning was by 73% of the surveyed farmers not perceived as a problem that needed to be addressed whereas this was 57% for aggression at the grower/finisher facilities. Older farmers considered aggression at the grower/finisher facilities as less of a concern than younger farmers. Few farmers mentioned aggression as a serious problem. The issues that farmers perceive as causes of aggression differ from what has currently been the research focus. A better alignment between concerns from practice and research objectives is recommended in order to achieve actual improvements in animal welfare.

Acknowledgements

This research was funded by the Biotechnology and Biological Sciences Research Council (BBSRC). SRUC receives financial support from the Scottish Government. We are grateful to the many pig farmers who responded to the survey. We thank the employees of Devnet Limited, and especially Jarfor Abu who kindly entered the results of the survey, Alan Whibley who provided information on farmers' participation in surveys, and Sarah Ison and Carol Thompson for their useful suggestions on the survey design.

Supplementary files. S1. Survey

References

- Alarcon, P., Wieland, B., Mateus, A. L., & Dewberry, C. (2014). Pig farmers' perceptions, attitudes, influences and management of information in the decision-making process for disease control. *Preventive Veterinary Medicine*, 116(3), 223-242.
- AHDB (2015). The BPEX Yearbook 2014-2015. Key industry statistics, pig performance data and details of knowledge transfer, research and development activity. Retrieved 25 July 2016, <http://pork.ahdb.org.uk/media/73777/bpex-yearbook-2015.pdf>.
- Benard, M., Schuitmaker, T. J., & de Cock Buning, T. (2014). Scientists and Dutch pig farmers in dialogue about tail biting: Unravelling the mechanism of multi-stakeholder learning. *Journal of Agricultural and Environmental Ethics*, 27(3), 431-452.
- Bock, B. B., & van Huik, M. M. (2007). Animal welfare: the attitudes and behaviour of European pig farmers. *British Food Journal*, 109(11), 931-944.
- Bracke, M. B. M., De Lauwere, C. C., Wind, S. M., & Zonerland, J. J. (2013). Attitudes of Dutch pig farmers towards tail biting and tail docking. *Journal of Agricultural and Environmental Ethics*, 26(4), 847-868. DOI: 10.1007/s10806-012-9410-2
- Broom, D. M. (2010). Animal welfare: an aspect of care, sustainability, and food quality required by the public. *Journal of Veterinary Medical Education*, 37(1), 83-88.
- D'Eath, R. B. (2005). Socialising piglets before weaning improves social hierarchy formation when pigs are mixed post-weaning. *Applied Animal Behaviour Science*, 93(3), 199-211.
- D'Eath, R. B., Niemi, J. K., Ahmadi, B. V., Rutherford, K. M. D., Ison, S. H., Turner, S. P., Anker, H.T., Jensen, T., Busch, M.E., Jensen, K.K., & Lawrence, A. B. (2015). Why are most EU pigs tail docked? Economic and ethical analysis of four pig housing and management scenarios in the light of EU legislation and animal welfare outcomes. *Animal*, 10(4), 687-699.
- Defra (2014). Agriculture In the United Kingdom 2013. Retrieved from www.gov.uk on 25 July 2016.

- Defra (2015). Farm structure survey 2013 : focus on agricultural labour in England and the United Kingdom. Retrieved from www.gov.uk on 25 July 2016.
- de Groot, J., Ruis, M. A., Scholten, J. W., Koolhaas, J. M., & Boersma, W. J. (2001). Long-term effects of social stress on antiviral immunity in pigs. *Physiology & Behavior*, 73(1), 145-158.
- de Lauwere, C., van Asseldonk, M., van't Riet, J., de Hoop, J., & ten Pierick, E. (2012). Understanding farmers' decisions with regard to animal welfare: The case of changing to group housing for pregnant sows. *Livestock Science*, 143(2), 151-161.
- Fox, M.W. (1984). Empathy, humaneness and animal welfare. In: M.W. Fox & L.D. Mickley (Eds.), *Advances in animal welfare science 1984/85* (pp. 61-73). Washington, DC: The Humane Society of the United States.
- Hemsworth, P. H., Mellor, D. J., Cronin, G. M., & Tilbrook, A. J. (2015). Scientific assessment of animal welfare. *New Zealand Veterinary Journal*, 63(1), 24-30.
- Hessel, E. F., Reiners, K., & Van den Weghe, H. A. (2006). Socializing piglets before weaning: Effects on behavior of lactating sows, pre-and postweaning behavior, and performance of piglets. *Journal of Animal Science*, 84(10), 2847-2855.
- Ison, S. H., & Rutherford, K. M. D. (2014). Attitudes of farmers and veterinarians towards pain and the use of pain relief in pigs. *The Veterinary Journal*, 202(3), 622-627.
- Jensen, P., & Redbo, I. (1987). Behaviour during nest leaving in free-ranging domestic pigs. *Applied Animal Behaviour Science*, 18(3), 355-362.
- Kauppinen, T., Vesala, K. M., & Valros, A. (2012). Farmer attitude toward improvement of animal welfare is correlated with piglet production parameters. *Livestock Science*, 143(2), 142-150.
- Keeling, L. J. (2005). Healthy and happy: animal welfare as an integral part of sustainable agriculture. *AMBIO: A Journal of the Human Environment*, 34(4), 316-319.

- Kutzer, T., Bünger, B., Kjaer, J. B., & Schrader, L. (2009). Effects of early contact between non-littermate piglets and of the complexity of farrowing conditions on social behaviour and weight gain. *Applied Animal Behaviour Science*, 121(1), 16-24.
- Ledergerber, K., Bennett, B., Diefenbacher, N., Shilling, C., & Whitaker, B. D. (2015). The effects of socializing and environmental enrichments on sow and piglet behavior and performance. *The Ohio Journal of Science*, 115(2), 8.
- Lund, V., Coleman, G., Gunnarsson, S., Appleby, M. C., & Karkinen, K. (2006). Animal welfare science – Working at the interface between the natural and social sciences. *Applied Animal Behaviour Science*, 97(1), 37-49.
- Maletínská, J., & Špinka, M. (2001). Cross-suckling and nursing synchronisation in group housed lactating sows. *Applied Animal Behaviour Science*, 75(1), 17-32.
- Marchant-Forde, J. N., & Marchant-Forde, R. M. (2005). Minimizing inter-pig aggression during mixing. *Pig News and Information*, 26(3), 63N-71N.
- McGlone, J. J. (1986). Agonistic behavior in food animals: review of research and techniques. *Journal of Animal Science*, 62(4), 1130-1139.
- McGlone, J. J. (2013). The future of pork production in the world: Towards sustainable, welfare-positive systems. *Animals*, 3(2), 401-415.
- Millman, S. T., Duncan, I. J., Stauffacher, M., & Stookey, J. M. (2004). The impact of applied ethologists and the International Society for Applied Ethology in improving animal welfare. *Applied Animal Behaviour Science*, 86(3), 299-311.
- Morgan, T., Pluske, J., Miller, D., Collins, T., Barnes, A. L., Wemelsfelder, F., & Fleming, P. A. (2014). Socialising piglets in lactation positively affects their post-weaning behaviour. *Applied Animal Behaviour Science*, 158, 23-33.

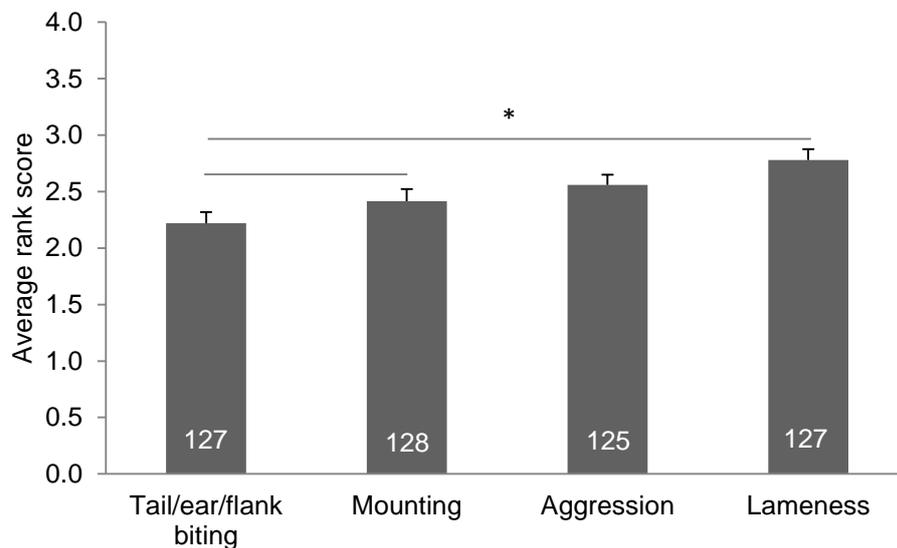
- Nicholls, A. (Ed.). (2006). *Social entrepreneurship: New models of sustainable social change*. Oxford University Press, Oxford.
- Spooner, J. M., Schuppli, C. A., & Fraser, D. (2014). Attitudes of Canadian pig producers toward animal welfare. *Journal of Agricultural and Environmental Ethics*, 27(4), 569-589.
- Tan, S. S. L., Shackleton, D. M., & Beames, R. M. (1991). The effect of mixing unfamiliar individuals on the growth and production of finishing pigs. *Animal Production*, 52(01), 201-206.
- Taylor, N. R., Main, D. C., Mendl, M., & Edwards, S. A. (2010). Tail-biting: a new perspective. *The Veterinary Journal*, 186(2), 137-147.
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219.
- Turner, S. P., D'Eath, R. B., Roehe, R., & Lawrence, A. B. (2010). Selection against aggressiveness in pigs at re-grouping: practical application and implications for long-term behavioural patterns. *Animal Welfare*, 19(S), 123-132.
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1), 126-136.
- Velarde, A., Fàbrega, E., Blanco-Penedo, I., & Dalmau, A. (2015). Animal welfare towards sustainability in pork meat production. *Meat Science*, 109, 13-17.
- Verdon, M., Hansen, C. F., Rault, J. L., Jongman, E., Hansen, L. U., Plush, K., & Hemsworth, P. H. (2015). Effects of group housing on sow welfare: A review. *Journal of Animal Science*, 93(5), 1999-2017.

Wattanakul, W., Stewart, A. H., Edwards, S. A., & English, P. R. (1997). Effects of grouping piglets and changing sow location on suckling behaviour and performance. *Applied Animal Behaviour Science*, 55(1), 21-35.

Wilson, R. L., Holyoake, P. K., Cronin, G. M., & Doyle, R. E. (2014). Managing animal wellbeing: a preliminary survey of pig farmers. *Australian Veterinary Journal*, 92(6), 206-212.

Figure caption

Figure 1. Welfare issues ranked in terms of the importance in response to the question: “Please rank the issues below from 1 – 4 based on what you think is most important to reduce, with 1 as most important”. Lower mean scores (with SE) therefore represent those issues rated as the most important to reduce at the grower/finisher phase. The number in each bar represents the number of respondents who assigned a score for the topic.

Figure 1

Tables

Table 1. The percentage and number of respondents per farm type with number of pigs per farm type in means with SE and range.

Farm type	% (n)	Sows	Weaners	Grow/finishers
Breeder-finisher	68 (114)	585 ± 123 (0-7000)	2207 ± 586 (0-40000)	3259 ± 873 (0-70000)
Breeder-weaner	6 (10)	718 ± 433 (15-4500)	449 ± 188 (40-1600)	130 ± 94 (0-405)
Grower-finisher	19 (32)	0	912 ± 297 (0-2000)	1291 ± 187 (24-5000)
Other	7 (11)	1 ± 1 (0-3)	540 ± 409 (0-2500)	669 ± 359 (0-2700)

Table 2. Respondents' answer to the question "When does the group composition change at your farm? I.e. when do you mix pigs?" given by farm type. Values are the percentage (out of total 167 respondents) and number of respondents (in brackets) per farm type.

	Breeder- finisher	Grower- finisher	Breeder- weaner	Other
When do you mix?				
Never	8 (9)	31 (10)	20 (2)	36 (4)
At weaning	85 (96)	13 (4)	80 (8)	27 (3)
At grower	33 (36)	31 (10)	100 (10)	9 (1)
At finisher	20 (23)	13 (4)	.	.
Before slaughter	15 (17)	25 (8)	.	.
At another moment	6 (7)	6 (2)	10 (1)	36 (4)

Table 3. Breeders response to the question “If mingling two or more litters before weaning would considerably reduce aggression, would you implement it?” given in percentage and number of breeders (respondents with breeder-weaner farm or breeder-to-finisher farm).

Response	% (n) breeders
Yes, in general to reduce stress or to increase welfare	24 (25)
Only if it would have positive effects on production	26 (27)
No, because of difficulties with management	27 (28)
No, in any case I wouldn't co-mingle pigs before weaning	22 (23)

Table 4. Breeders response to the question “What would be your concerns against mingling whole litters per-weaning?” given in percentage and number of breeders.

Concern	% (n)
Practical management of piglets and sows	60.2 (74)
Aggression of the sow towards piglets	37.4 (46)
Reduced growth of piglets	31.7 (39)
Fighting between piglets at co-mingling	26.8 (33)
Cross-suckling	25.2 (31)
Disruption of suckling bouts	22.0 (27)
Overall more stress	17.1 (21)
Other	13.0 (16)