

Environmental enrichment in pig husbandry – Citizens' ratings of pictures showing housing elements using an online-survey



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ABSTRACT

The level of animal welfare in intensive pig production has been subject to increasing public criticism in recent years. Previous studies revealed a clear citizens' demand for more species-appropriate pig husbandry systems with various enriching housing elements that ensure adequate behaviour and animal welfare. However, despite intense public debates, to the best of our knowledge, no research has been done to examine a more differentiated rating by citizens of enriching housing elements that can potentially be integrated in farming systems and thus increase social acceptance. Against this background, 14 housing elements were selected that are known to potentially enrich the pigs' environment. We used a picture-based survey design to show participants what each element looks like. Participants were recruited through an online panel provider using quota sampling. 414 German citizens were asked to rate the selected enrichment elements. In addition to compare the rating of enrichment elements, we conducted a cluster analysis based on the participants' attitudes towards animal welfare. Participants believed nine out of the 14 housing elements to have a positive influence on animal welfare and to be an important element in a pigsty. Wallows were appreciated the most, closely followed by straw as bedding and enrichment material in a separate rooting area. Showers, tubs, and straw as enrichment material in containers were rated positively as well, although to a lesser extent. In contrast, the slatted outdoor area and all four enriching objects (toys) performed comparatively poorly. Overall, costs associated with the installation/usage of the respective housing elements were rated rather low, and practicability issues were mostly rated as negligible. We identified two citizen segments that showed different ratings of the housing elements and which also differed in gender, meat consumption patterns, interest in agricultural topics, and self-perceived knowledge of animal husbandry. The findings are valuable for farmers to adapt their production systems. Wallows, straw bedding and rooting areas can improve the animal welfare perception from a citizens' point of view, although there seem to be different citizen segments. Simple toys and slatted areas, even outdoors, seem to be less appropriate when communicating improved husbandry systems to the public.

1. Introduction

Current livestock production is mainly characterised by intensive production systems, where large numbers of animals are kept in a confined space. Whilst the improved efficiency of such modern practices results in lower prices for consumers, animal welfare can be neglected (Krystallis et al., 2009; Meyer-Hamme et al., 2018). In such production systems, pigs are often kept in barren housing conditions on slatted floors without any bedding or enrichment material, and outdoor access is not provided (Barnett et al., 2001; van de Weerd and Day, 2009; Zander et al., 2013). In Germany, which is the largest pig producer in the EU, more than 90 percent of all pigs are kept in housing

systems with slatted floors (Statistisches Bundesamt, 2011). In contrast, the number of housing systems with bedding material or outdoor access is relatively small (Statistisches Bundesamt, 2011). Under these conditions, it is difficult for the pigs to express various natural and highly motivated behaviour patterns, including exploration and foraging (van de Weerd and Day, 2009), or cooling themselves when it is hot by seeking appropriate wet places (Hsia et al., 1974). As a result, pigs in such intensive systems often redirect their explorative behaviour on pen mates (i.e. tail- and ear-biting) or wallow in their own dung to reduce body temperature, both of which can cause health problems and thus negatively affect animal welfare (Barnett et al., 2001; European Food Safety Authority, 2007).

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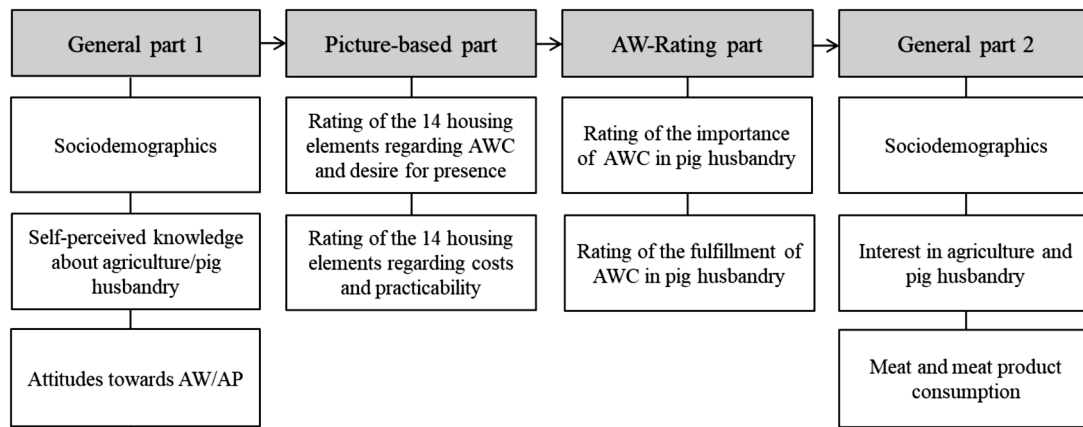


Fig. 1. Structure and thematic blocks of the questionnaire used in the online survey with 414 German residents. AW = Animal welfare; AP = Animal protection; AWC = Animal welfare criteria; Query of self-perceived knowledge on a 5-point Likert scale from 1 = extremely low, 2 = rather low, 3 = middle, 4 = rather high and 5 = extremely high. Query of attitudes towards AW/AP, rating of the 14 housing elements and rating of the fulfilment of AWC in pig husbandry on a 5-point Likert scale from 1 = completely disagree, 2 = rather disagree, 3 = partly/partly, 4 = rather agree, 5 = totally agree. Rating of the importance of AWC in pig husbandry on a 5-point Likert scale from 1 = not important at all, 2 = rather not important, 3 = partly, partly, 4 = rather important, 5 = extremely important. Query of interest on a 5-point Likert scale from 1 = not at all, 2 = rather not, 3 = partly/partly, 4 = little and 5 = much.

Citizens' attitudes towards food production are no longer determined only by nutritional, beneficial, risk-related, or economic factors. Ethical and moral concerns play an increasingly important role (Frewer et al., 2005). Therefore, it is not surprising that animal husbandry and the state of animal welfare in such intensive production systems are increasingly becoming subject of public criticism in many European countries, including Germany (Eurobarometer, 2016; Krystallis et al., 2009; Weible et al., 2016).

There are various scientific approaches to define the term 'animal welfare', which demonstrates its multidimensional nature (Blokhuis et al., 2013b). However, the most prominent definition is that of Fraser et al. (2013), describing animal welfare as comprising of three concerns, namely natural-living, affective states, and biological functioning. In the public's perception of animal welfare, the term 'natural' is often referred to in the context of housing system, feeding, breeding methods, the use of medicines, and any farmer-animal contact (Boogaard et al., 2011; Boogaard et al., 2008; Weible et al., 2016). In other words, the public's desire for farm animal welfare comprises natural animal behaviour in a natural environment (Webster, 2001).

According to many people's preference for naturalness and the current state of pig production, there is public concern about the appropriateness of intensive pig husbandry systems and a demand for more natural and species-appropriate production systems (Boogaard et al., 2011; Zander et al., 2013). For example, outdoor access (Boogaard et al., 2011; Wildraut et al., 2015; Zander et al., 2013) and natural floor conditions (i.e. straw, grass, mud) (Boogaard et al., 2011; Busch et al., 2019; Wildraut et al., 2015) are perceived as an improvement to animal welfare. Accordingly, providing enrichment material or objects (Boogaard et al., 2011; Wildraut et al., 2015; Zander et al., 2013) and installing sprinklers or mud wallows for cooling purposes (Boogaard et al., 2011; Lassen et al., 2006) provides a benefit for the animals and might also be in line with public attitudes. Nevertheless, it is not clear how such environmental enrichment is perceived and rated by laypersons.

To the best of our knowledge, there is no study that addresses the citizens' perception of enriching housing elements. In the face of the discussion around current pig husbandry systems, it is valuable to assess how different housing enrichments are perceived by citizens in order to determine whether animal welfare improvements (i.e. environmental enrichment) have the potential to be socially acceptable and thus can be used when communicating with the public.

Therefore, the aim of our study was:

- 1) to analyse how citizens rate different enriching housing elements with regard to:
 - a) benefits for animal welfare and
 - b) costs and practicability of the respective elements and
- 2) to identify citizen segments regarding animal welfare attitudes and differences between segments regarding the rating of the housing elements and sociodemographic characteristics.

To answer the research questions, 414 German residents were questioned online using a standardised picture-based questionnaire with closed-ended questions in March 2018.

2. Material and methods

2.1. Study design

We used a standardised online questionnaire with a cross-sectional design to collect data.

We opted for a picture-based presentation of the housing elements within the questionnaire, as many participants might not have known exactly what the housing elements look like. In order to make it easier for participants to understand the purpose of the housing elements, we selected pictures that showed pigs with the respective element. As both the environment and the animal displayed on a picture influence how they are perceived by a person (Busch et al., 2019), we instructed participants in the introduction of the questionnaire to primarily concentrate on the housing element rather than on the environment or the animals themselves. To ensure realistic pictures, we discussed the pictures with an animal welfare organisation and a farmer's federation. Both agreed that our selection represented realistic scenarios and were not glossed over. Pictures of the 14 housing elements were presented within the online survey on seven consecutive but randomised pages with similar elements appearing together on one page (for example 'outdoor area slatted floor' appeared together with 'outdoor area straw bedding', 'rooting tower' together with 'straw basket' or 'rope' together with 'wooden block'). Thus, on the one hand, small differences between similar pictures (housing elements) were made apparent and on the other hand, the total number of pages was reduced, which usually helps to maintain the participants' motivation to answer the survey entirely.

2.2. Structure of the questionnaire

The questionnaire consisted of four parts (Fig. 1). The first part

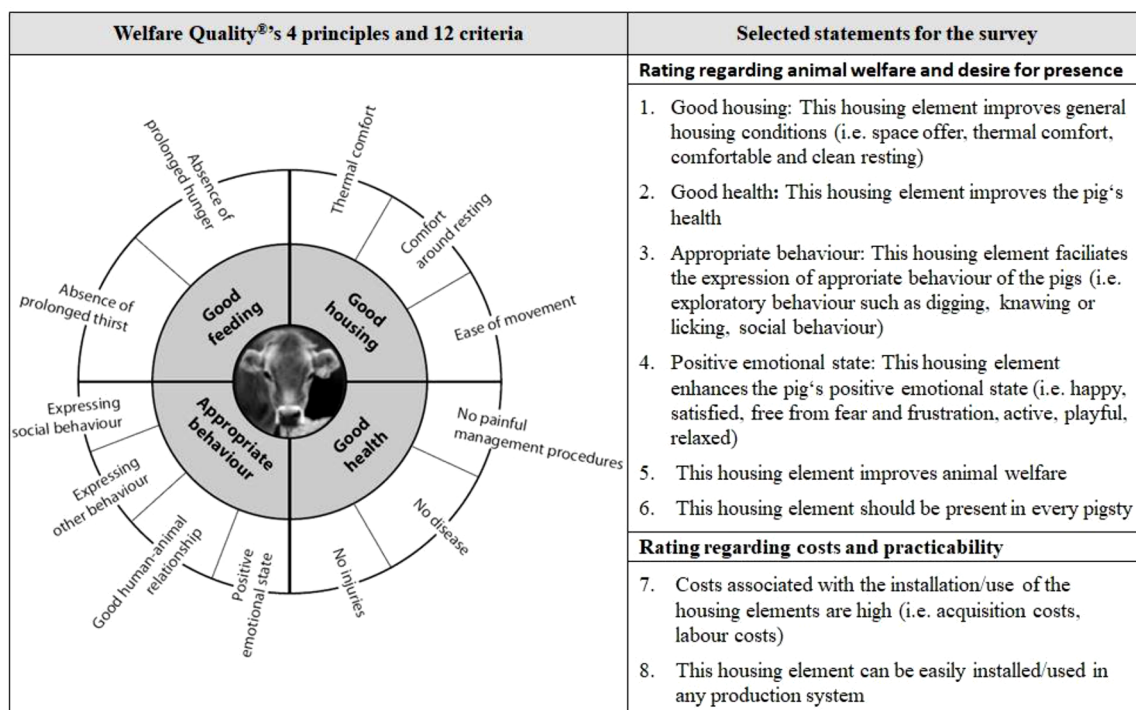


Fig. 2. Welfare Quality®'s 4 principles and 12 criteria and the eight statements for the picture-based rating of the 14 housing elements in the survey presented therein. Three of four of the Welfare Quality® principles were used for the survey: while the principle 'good feeding' was not used, the criteria 'positive emotional state' was integrated as an extra point. Rating of the statements on a 5-point Likert scale from 1 = completely disagree, 2 = rather disagree, 3 = partly/partly, 4 = rather agree, 5 = totally agree. *Source:* adapted and modified from Keeling et al., 2013.

included questions about sociodemographic characteristics, self-perceived knowledge about animal husbandry and natural behaviour patterns of pigs (using a 5-point Likert scale from 1 = extremely low to 5 = extremely high), as well as questions concerning the participants' attitudes towards animal protection/welfare (using a 5-point Likert scale from 1 = completely disagree to 5 = totally agree). In the next part, participants were shown 14 pictures of the housing elements (one picture for each element resulting in a total of 14 pictures). The pictures were accompanied by a brief description of the displayed element (e.g. description of the housing element 'outdoor area straw': this picture shows an outdoor area with straw bedding, description of the housing element 'plastic block': this picture shows a hanging block of plastic attached to a chain, description of the housing element 'wallow': this picture shows a wallow consisting of water and mud outside the stable). Subsequently, participants were asked to indicate their level of agreement with eight statements referring to the welfare implications of the housing elements and the perceived costs and practicability of installing them in a pigsty (using 5-point Likert scales from 1 = completely disagree to 5 = totally agree). The selection of statements is described in Section 2.3 (Fig. 2). In the third part of the questionnaire, participants were asked to rate the fulfilment of animal welfare criteria under conventional pig housing conditions (using a 5-point Likert scale from 1 = completely disagree to 5 = totally agree) and to indicate how important the fulfilment of the respective animal welfare criterion was to them (using a 5-point Likert scale from 1 = not important at all to 5 = extremely important). We used the same five animal welfare-related items as for the rating of the housing elements. Finally, the questionnaire ended with a part containing questions about socio-demographic characteristics, participants' interest in agriculture and pig husbandry (using a 5-point Likert scale from 1 = not at all to 5 = much), and their meat and meat product consumption (response options: I eat much/rather much/average amount/rather little/few meat and/or meat products, I do not eat meat or meat products expect fish, I'm vegan, I'm vegetarian).

2.3. Selection of welfare criteria for the survey

The general requirements that contribute to an appropriate state of animal welfare can be found in the 'Five Freedoms' (FAWC, 1992). This multidimensional approach was used as a starting point within the 'Welfare Quality® Project' in order to develop European standards for assessing animal welfare (Keeling et al., 2013; Blokhuis et al., 2010). Since a balanced welfare assessment system has to be accepted by a broad stakeholder group, consumers, farmers, industry, legislators, as well as scientists were involved in the Welfare Quality® project and jointly developed four principles (i.e. good feeding, good housing, good health, and appropriate behaviour) with twelve assignable criteria (Fig. 2) (Blokhuis et al., 2013a; Keeling et al., 2013).

We decided to incorporate the extensively developed criteria of the 'Welfare Quality® Project' into our questionnaire because of their practical feasibility, and because the classification seemed most suitable for the rating of the selected housing elements. Since using each subcategory as an extra rating-point would have protracted our questionnaire, and since some were not suitable for our purpose, we focused on three of the four main principles and indicated respective criteria as examples in parentheses or summarised them. The principle 'good feeding' was not included. The absence of hunger and thirst might be regarded as self-evident by lay-people and in addition, we could not come up with a statement on good feeding that is suitable for all tested housing elements. Furthermore, we omitted the two subcategories 'absence of pain induced by management procedures' and 'good human-animal relationship' which probably would not be associated with any of the housing elements at first glance and thus would not be adequate and overstrain lay participants. In addition, we decided to integrate 'positive emotional state' as an extra rating-point, since the emotional state is gaining increasing scientific acknowledgement in the assessment of animal welfare (Fraser et al. 1997; Fraser et al., 2013) and because it is also an important aspect of the public's perception of animal welfare (Duncan, 2005, 2002). Fig. 2 shows the Welfare Quality

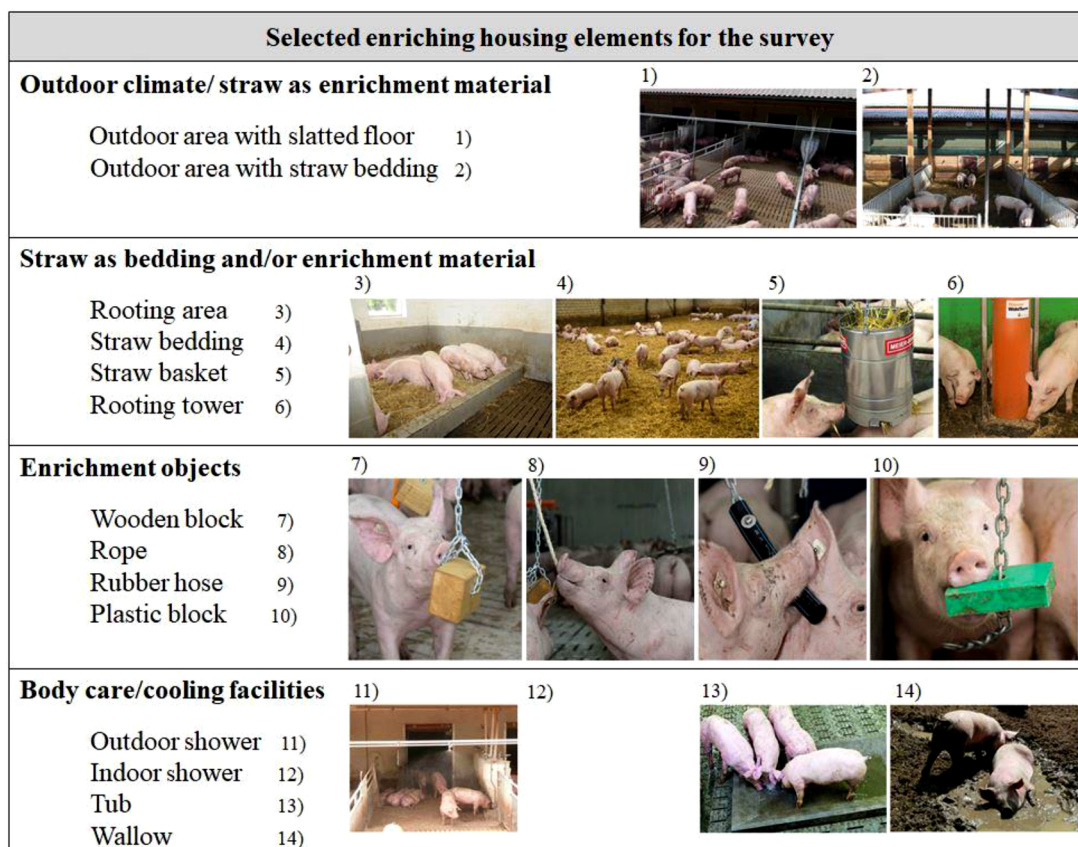


Fig. 3. Pictures of the selected enriching housing elements for the survey. *Source:* 4) 10) Bildagentur Agrarmotive; 3) Bildagentur Agrarpress; 6) Haus Düsse; 5) Meier-Brakenberg; 11) 1) ÖKL-Baupreis 2012, www.oekl-bauen.at; 13) Hölscher + Leuscher; 14) Verein Happy Pigs & Friends; 7) 8) 9) Bildagentur Landpixel; 2) J. Püttker (ISN); 12) Due to image license problems, the picture of the ‘indoor shower’ can only be viewed under the following link (the picture appears at 5th position in the gallery): <https://www.br.de/kinder/meerschweinchen-haustiere-100.html>. The original picture shows several pigs, with one of them standing under a shower inside the stable. However, only a small section of the picture was used for our survey, showing the showering pig and a small part of the back of the pig standing in front of it.

protocol on the left and the statements used in our survey on the right.

2.4. Definition of environmental enrichment and selection of enriching housing elements for the survey

In the literature there are different definitions of the term ‘environmental enrichment’, but it generally implies a benefit to the animals (Newberry, 1995). It can be described as a possibility to beneficially modify the environment of captive animals (Shepherdson, 1994), with specific goals ranging from increasing behavioural diversity, reducing the occurrence of abnormal behaviours, up to enhancing normal (i.e. wild) behaviour patterns (Young, 2003), which are important for improving animal welfare (Hare and Sevenich, 2001). There are many possibilities to enrich the environment (Young, 2003). Bloomsmith et al. (1991) identified five major categories: 1) physical environment, 2) social companionship, 3) psychological occupation and exercise, 4) sensory stimuli, and 5) nutritional delivery and type.

Fig. 3 shows the enrichment elements selected for our study. We chose to focus on enriching elements that are part of the physical environment (Bloomsmith et al., 1991), because in pig husbandry, the design of the physical environment plays a major role in improving the state of animal welfare. Various studies have examined the environmental enrichment of pig housing systems, with a large proportion focusing on how farmers use enriching substrates or objects in their stalls (van de Weerd and Day, 2009). These more simple forms of enrichment are commonly used in intensive production systems in order to enable pigs to perform species-specific behaviour and reduce undesirable behaviour such as tail biting (van de Weerd and Ison, 2019). However,

there is clear evidence that not only enrichment materials such as straw or other objects have the potential to improve animal welfare. In organic pig husbandry, for example, the use of outdoor areas, or even wallows or sprinklers as cooling facilities, are also key elements (Kijlstra and Eijck, 2006; Spoolder, 2007; Sundrum, 2001). Besides outdoor areas (with straw bedding or a slatted floor), wallows, tubs or sprinklers (inside the stable and in the outdoor area), we also selected the enriching substrate straw (as bedding in the stable, in the form of a separate rooting area, and as enrichment material in two different containers), as well as four enriching objects (toys) in the citizen survey (Fig. 3). Thus, we based our selection on those enrichment elements that are already used in pig farming practice to provide realistic insights.

2.5. Sample

To achieve representativeness in some sociodemographic characteristics of the German population, participants were recruited through an online panel provider in March 2018. In attitude and marketing research, online panels are frequently used for recruiting participants. Thereby, the panel provider (a firm specialized in recruiting participants) is commissioned and paid to provide a certain number of respondents from its crowd that fulfil requested socio-demographic characteristics. In our case, participants were selected using quota sampling with gender, age, place of residence (North, South, East, and West Germany) and school education as quota control criteria based on the general population in Germany (Table 1). Out of a total of 441 participants who completed the survey, 27 were removed from the final

Table 1
Sociodemographic characteristics of the sample and the German population.

	Specification	Sample (%)	German population (%)
Gender^a	Female	51.9	50.7
	Male	48.1	49.3
Age in years^a	18-29	17.1	16.9
	30-39	14.0	14.9
	40-49	15.2	16.0
	50-59	19.6	19.1
	60 and older	33.8	33.0
Place of residence^b	South ¹	29.0	28.9
	North ²	16.2	16.1
	East ³	20.5	19.6
	West ⁴	34.3	35.4
Education^c	No educational qualifications	3.9	4.0
	Secondary school (low)	32.1	31.4
	Secondary school (high)	29.2	29.4
	Higher education entrance qualification	30.9	30.8
	Still in education	3.9	3.6

N = 414; Statistisches Bundesamt Germany 2015^b; 2016^a; 2017^c

¹ Bavaria, Baden-Wuerttemberg

² Bremen, Hamburg, Lower-Saxony, Schleswig-Holstein

³ Brandenburg, Berlin, Saxony, Saxony-Anhalt, Thuringa, Mecklenburg-Western Pomerania

⁴ Hestia, North Rhine-Westphalia, Rhineland-Palatinate, Saarland.

dataset because they were either identified as speeders (i.e. too fast response time) or straightliners (i.e. no variance in response behaviour), which are both routine procedures to improve data quality especially in online surveys (Shamon and Berning, 2020). In our study, participants were classified as speeders, if their response time was less than half of the median response time of the overall sample (less than 8.56 minutes), which was the case for 20 participants. With regard to straightlining-behaviour, a highly frequent selection of the same answer category within a question or between questions, led to exclusion, which was the case for 7 participants. The final sample size included 414 respondents.

2.6. Statistical analysis

Data were analysed using IBM SPSS Statistics 24. For descriptive purposes, we used mean scores, standard deviations and frequencies. We examined the internal consistency of several items using the Cronbach's alpha (CRA) to reduce the set of variables in the dataset and to improve scale strength. Furthermore, we carried out a factor analysis to reduce the number of variables concerning the attitude towards animal protection/welfare and to build valid constructs (Bühl, 2010). Moreover, we conducted a hierarchical cluster analysis to detect different citizen segments (clusters), which are characterised by homogeneity within and heterogeneity between clusters regarding certain response behaviours. Finally, we used one-way analysis of variance (ANOVA) and cross-tabulation with χ^2 -tests to detect differences between citizen segments. All tests were two-tailed, and the significance level was set at 0.05.

We proved the internal consistency using CRA of six of the eight items of the picture-based rating section (five directly referring to the potential benefit to animal welfare and one asking for the desire regarding presence in a pigsty). As the CRA with ≥ 0.9 was excellent (Hair et al., 1998) for all housing elements, we calculated an average mean score for each participant, including the welfare rating statements, and named it 'benefit to animal welfare and desire for presence'.

Furthermore, we examined the internal consistency of the five animal-welfare related statements used in the general animal welfare rating section (third part of the questionnaire). Since CRA was ≥ 0.9 again, we summarised the respective five items and calculated two new variables: 'importance of animal welfare criteria' and 'degree of fulfilment of animal welfare criteria'.

We used the principal component analysis to extract three factors from 16 variables concerning the attitude towards animal protection/welfare (Table A1). Items with low factor loadings (< 0.5) were neglected (Backhaus et al., 2008). The KMO-value (Kaiser-Meyer-Olkin test for sampling adequacy) with 0.913 was excellent (Kaiser and Rice, 1974), the Bartlett test for sphericity was significant with a p-value < 0.001 , and the explained total variance was 57.5%. Internal consistency revealed that the CRA of the item 'many consumers think that they don't have the power to change the animal protection situation anyway' was poor (0.405) (Hair et al., 1998); it was therefore omitted. The CRAs for all three factors were > 0.7 (CRA: factor 1 = 0.843; factor 2 = 0.818; factor 3: 0.780).

The cluster analysis was based on the extracted factors as well as on the mean scores of the new calculated variables 'importance of animal welfare criteria' and 'degree of fulfilment of animal welfare criteria'. In order to identify outliers, we used the nearest neighbour method and consequently excluded three participants from the cluster analysis. In the next step, we used Ward's method to find a two-cluster solution.

3. Results

3.1. Description of the sample

The socio-demographic distribution in the sample as well as the distribution in the German population can be found in Table 1.

3.2. Rating of the housing elements

For nine of the 14 housing elements, participants believed them to have a positive influence on animal welfare and to be an important element in a pigsty (Fig. 4). The rating for 'wallow' was best (mean = 4.34; SD = 0.83), closely followed by 'straw bedding', 'rooting area', and 'outdoor area straw'. A rather neutral rating of welfare benefits was observed for all four enriching objects (toys), as well as for the 'outdoor area slatted floor', with the latter showing the lowest perceived benefit (mean = 2.70; SD = 1.03) (Fig. 4).

Regarding the costs associated with the installation/use of the housing elements, the overall cost was perceived as relatively low (Fig. 4). There was very little agreement that costs would be high for the 'outdoor shower' (mean = 3.16; SD = 1.00) and 'indoor shower' (mean = 3.03; SD = 1.04). Costs were rated lowest in the case of the four enriching objects (toys) (Fig. 4).

On average, participants answered affirmatively to all elements when asked if they believed the housing element could be easily installed (Fig. 4). The lowest agreement in this case could be found for the 'outdoor area with slatted floor' (mean = 3.16; SD = 1.07), which means that practicability for this housing element is considered to be the least easy compared to the others.

3.3. Citizen segments based on attitudes towards animal protection and welfare

The first factor that could be extracted was named 'importance of animal protection/welfare', the second one 'rating of the current animal husbandry' and the third 'responsibility of policy and farmers' (respective items and factor loadings can be found in Table A1).

The hierarchical cluster analysis was based on the three factors, as well as on the perceptions on current animal welfare criteria under conventional housing conditions and the importance of the fulfilment of animal welfare criteria. We identified two clusters:

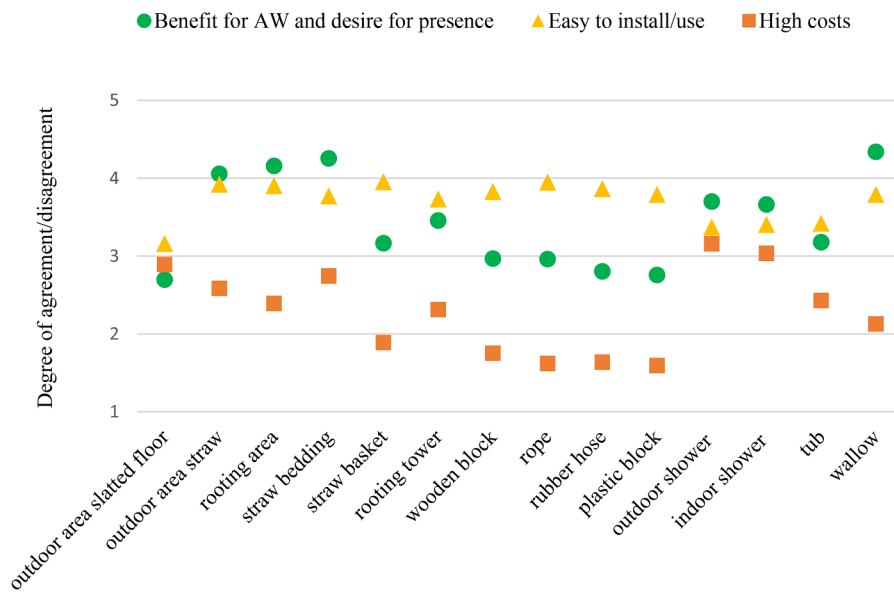


Fig. 4. Rating of the housing elements regarding benefit for animal welfare and desire for presence, practicability and costs. AW = Animal welfare; Rating on a 5-point Likert scale with 1 = completely disagree, 2 = rather disagree, 3 = partly/partly, 4 = rather agree, 5 = totally agree. For the five items referring to the benefit the housing elements add to AW and the one referring to the desire for presence in a pigsty, we calculated a new variable or rather mean score called ‘benefit for AW and desire for presence’ (CRA = ≥ 0.9 for all housing elements).

Table 2

Two-cluster solution based on the mean scores of the three evaluated factors and the rating regarding the importance and the degree of fulfilment of animal welfare criteria.

Cluster-building variables	Cluster 1 Mean (SD)	Cluster 2 Mean (SD)	P-values (F)
Importance of animal protection/welfare (factor 1)	1.49 (0.36)	2.34 (0.62)	<0,001 (263,1)
Rating of the current animal husbandry (factor 2)	2.26 (0.67)	2.95 (0.67)	<0,001 (105,4)
Responsibility of policy and farmers (factor 3)	4.69 (0.42)	3.98 (0.65)	<0,001 (159,2)
Importance of animal welfare criteria	4.90 (0.21)	4.22 (0.55)	<0,001 (244,8)
Degree of fulfilment of animal welfare criteria	2.19 (0.70)	3.38 (0.84)	<0,001 (230,7)

Cluster 1: n = 175 (42.6%); cluster 2: n = 236 (57.4%); SD = Standard deviation; 5-point Likert scale from 1 = completely disagree, 2 = rather disagree, 3 = partly/partly, 4 = rather agree, 5 = totally agree for the cluster-building variables 1, 2, 3 and 5 and from 1 = not important at all, 2 = rather not important, 3 = partly, partly, 4 = rather important, 5 = extremely important for the cluster-building variable 4; mean scores can be interpreted as follows: factor 1: the lower the mean score the higher the importance of animal protection/welfare, factor 2: the higher the mean score, the better the rating of the current animal husbandry, factor 3: the higher the mean score, the more responsibility for ensuring animal protection is attributed to policy and farmers, importance of the fulfilment of animal welfare criteria: the higher the mean score, the higher the importance of fulfilment of animal welfare criteria, degree of fulfilment of animal welfare criteria: the higher the mean score, the higher the estimated fulfilment of animal welfare criteria; comparison of mean scores of all five cluster-building variables between the two clusters by using ANOVA.

The first cluster included 42.6% (n = 175) of participants, and the second cluster represented 57.4% of the sample (n = 236). Comparison of mean scores revealed differences (p < 0.05) between the clusters for all five cluster-building variables (Table 2). For participants in cluster 1, animal protection/welfare was more important (factor 1) than for those belonging to cluster 2. Both clusters believed in a high responsibility of policy and farmers to ensure animal protection (factor 3), although this rating was higher in the first cluster. Cluster 1 participants rated the current animal husbandry (factor 2), as well as the degree of fulfilment of animal welfare criteria in conventional pig husbandry systems, worse compared to participants in cluster 2. Furthermore, for cluster 1 participants, the fulfilment of animal welfare criteria was more important than it was for participants of the second cluster (Table 2).

Mean scores of the perceived benefit to animal welfare and desire for presence of the elements in the stable revealed that cluster 1 participants rated housing elements, which were already rated as not beneficial in the sample average, even worse, and those, which were rated beneficial on average, even better (except for the straw basket) compared to cluster 2 (Table A2). There were differences (p < 0.05) between most of the housing elements (Table A2). Additionally, participants in cluster 1 consistently rated costs lower and practicability easier compared to cluster 2 for most housing elements (p < 0.05) (Table A2).

In order to further characterise the two clusters, we studied socio-demographic and other personal data. The first cluster contained a

higher proportion of women (p < 0.05), and a higher share of non-pet owners in the cluster expressed the desire to own a pet (p < 0.05) (Table A3). Moreover, there were differences between the clusters with regard to meat and meat product consumption, with participants from the first cluster showing lower meat and meat product consumption and representing the major proportion of vegetarians and vegans of the total sample (p < 0.05) (Table A3). Furthermore, on average, cluster 1 participants indicated to be more interested in agriculture and pig husbandry and rated their knowledge of animal husbandry, as well as of natural behaviour patterns of pigs, higher than those of cluster 2 (p < 0.05) (Table A4). Concerning other characteristics such as age, household income, school education, place of residence, and urbanity of residence, we found no differences between the two clusters (Table A3).

4. Discussion

4.1. Rating of the housing elements

To laypersons, a dirty pig seems to indicate that the pig has the opportunity to express natural behaviours and thus lives an appropriate pig-life (Lassen et al., 2006; Wildraut et al., 2015). Against this background, it was not surprising to discover in this study that a ‘wallow’ was rated as an exceptionally suitable element to improve animal welfare in a pigsty, whereas an outdoor as well as an indoor shower and

a tub obtained less positive ratings. Even though participants seemed to appreciate the provision of cooling facilities for pigs in general, they showed a clear preference for the most natural version, a mud wallow.

With regard to flooring conditions, Wildraut et al. (2015) found that the sight of straw bedding released positive emotions in laypersons, and that they strongly expressed the desire for straw instead of the often used concrete (slatted) floor in modern pig production. In picture-based studies, slatted floors have been rated worse by citizens compared to straw bedding, and even a picture of an 'unhappy-looking pig' on straw resulted in a more positive rating of animal welfare compared to a picture showing a 'happy-looking pig' on a slatted floor (Busch et al., 2019). This is similar to our results, where the presence of straw bedding (in the stable as well as in the outdoor area) resulted in a positive rating in contrast to the slatted outdoor area, which was rated worst amongst all elements. Many studies have shown that there is a public demand for outdoor access, fresh air, and daylight for farm animals (Boogaard et al., 2011; Wildraut et al., 2015; Zander et al., 2013). The results presented in our study show a more differentiated picture of laypersons' perceptions. Apart from limited space and temporary access, participants might have criticised the unnatural ground in slatted outdoor areas (concrete floor) and preferred a natural surface instead (i.e. mud, grass) (Boogaard et al., 2011). This finding underpins the negatively established perception of a slatted floor in citizens' minds to such an extent that not even the added 'outdoor access' could increase its appreciation. In contrast, the 'rooting area' was rated extremely positively, although the surrounding ground on the picture showed a slatted floor. In this case, the separate straw rooting area seemed to compensate the simultaneous use of the slatted floor at least to some extent. Thus, a combination of both a slatted floor with areas with bedding material might be considered as an acceptable compromise for citizens. These findings are valuable, i.e. for farmers who are willing to modify their existing stables to meet social demands instead of building new stables, since such smaller animal welfare arrangements may be easier to integrate.

In the present study, straw was not only rated positively when offered as bedding but also when it was offered as enrichment material in containers (i.e. straw basket and rooting tower) to prevent boredom in the bare pens and to satisfy needs such as rooting and foraging. This finding is in line with other studies that have analysed the perception of straw (Boogaard et al., 2011; Busch et al., 2019; Wildraut et al., 2015; Zander et al., 2013). The fact that the rooting tower was appreciated more than the straw basket could be ascribed to the different locations of straw release. While the rooting tower allows rooting and eating on ground level, straw baskets only permit eating straw from above, which might be perceived as unnatural. It would have been interesting to study how citizens would have rated other types of straw such as chopped straw, which are beneficial with regard to manure handling in slatted floor systems compared to long straw (Bulens et al., 2016; van de Weerd and Day, 2009). However, we did not make any distinction between straw types for two reasons: firstly, citizens are usually laypersons, so we tried to keep it as simple as possible. Secondly, we needed to restrict to a few enrichment elements to keep the length of the questionnaire and participants' attention span in mind.

The fact that none of the enriching objects (toys) were rated as positive is partially consistent with results from other studies. Even though ropes, chains, and jerry cans have been found to be suitable enrichment elements (Boogaard et al., 2011), some people are sceptical about the benefit of such enrichment objects or do not even recognise them as such (Busch et al., 2017; Wildraut et al., 2015; Zander et al., 2013). We can assume that participants in the present study were unsure about the function or doubted that the application would sufficiently enrich the environment to improve animal welfare. Nevertheless, as the rating of the enrichment objects was rather neutral to only slightly not beneficial, participants would presumably prefer the enrichment objects over no enrichment at all. However, the benefit to animal welfare does not always appear to be clear to laypersons for all arrangements, which requires specific explanation to achieve citizen's appreciation, for example in the case of enriching elements such as

simple toys. Finally, differences in ratings between objects could be attributed to material characteristics. Rubber and plastic objects were probably considered less natural than wood and sisal and consequently led to a worse performance of 'plastic block' and 'rubber hose' compared to 'wooden block' and 'rope'.

Altogether, the results show that citizens' ratings regarding the benefit to animal welfare widely correspond to the scientifically proven positive value that the housing elements have to the pigs' welfare. For example, straw has been known to be of particular value as enrichment substrate for many years: it has shown positive effects on the activity level and reduced pen-mate-directed behaviour such as tail-biting, both when used as bedding and when provided in limited quantity as enrichment (i.e. in racks or hanging baskets) (Tuytens, 2005; van de Weerd and Day, 2009). In contrast, the level of benefit of enriching objects such as chains, plastic pipes, or car tyres is quite controversial in science (Bracke et al., 2006; van de Weerd et al., 2005; van de Weerd and Ison, 2019; van de Weerd and Day, 2009). In terms of cooling facilities, wallows are also considered to be beneficial from a scientific point of view. They provide higher welfare benefits compared to sprinklers, due to the extending effect of evaporative cooling through the mud layer and an additional protection from parasites (Huynh et al., 2006; Sambraus, 1991).

Overall, participants in our study did not rate the potential costs associated with the usage of the housing elements very highly. There was small agreement for the two showers only in that the application would be costly. This could be ascribed to participants associating high water consumption with the usage of showers. In contrast, cost-rating was lowest for the four enriching objects, which is unsurprising, as investment costs for such enriching objects are comparatively low, whereas the usage of straw as bedding and rooting substrate ad libitum, for example, increases the total rearing costs by 4-8% compared to conventional housing systems with a fully slatted floor (Bornett et al., 2003). Since participants rated costs rather low, they appeared to have only a limited understanding of the additional costs associated with environmental enrichment, which are a crucial factor in the economic sustainability of pig production.

Participants agreed to the statement 'this housing element is relatively easy to install/use' on a similar level for all housing elements. Thus, citizens have a limited understanding of the requirements for the installation/usage of several housing elements, which explains the rating of the cost expectations. Participants' opinion, for example, that a wallow could be installed/used as easily as a plastic block or a rooting tower, is quite misguided. In fact, the installation of a mud wallow is only possible in free-range systems (Brade and Flachowsky, 2006), whereas a plastic block or a rooting tower can be installed more easily in various housing systems.

4.2. Differences between citizen segments

Although there were differences between the two clusters, on average, all participants indicated that they value animal protection/welfare and that the fulfilment of animal welfare criteria play an important role. This is consistent with the overall increasing public concern about farm animal protection during the last decades (Bornett et al., 2003; Eurobarometer, 2016; Kendall et al., 2006; Miele et al., 2013; Verbeke, 2009). Additionally, both clusters attributed high responsibility to policy and farmers with regard to ensuring animal protection. Similar to previous studies, this includes the application of a stricter control system of compliance with regulations and improvement of animal protection (Rovers et al., 2017; Weible et al., 2016).

The higher critical perception of enrichment elements by cluster 1 participants could be attributed to several cluster characteristics, similar to other studies. According to prior surveys, women were found to be more concerned about farm animal welfare (Harper and Henson, 2001; María, 2006; McKendree et al., 2014), more critical regarding animal husbandry (Kayser et al., 2012b; María, 2006; McKendree et al., 2014), and rather opposed to pig husbandry compared to men (Zander et al., 2013). In addition, women tend to

consume less meat and meat products (Cordts et al., 2013; MRI, 2008). In general, people who tend to be highly concerned about animal welfare consume less meat and meat products (Cordts et al., 2013). Furthermore, pet owners were found to be more concerned about animal welfare (McKendree et al., 2014) and perceived the quality of life of farm animals to be lower (Boogaard et al., 2006) than non-pet owners. Secondly, participants from the first cluster had higher self-perceived knowledge of animal husbandry and were more interested in agricultural topics. Accordingly, a higher interest in agriculture (Zander et al., 2013) as well as better objective or subjective knowledge (Kayser et al., 2012a; Weible et al., 2016; Zander et al., 2013) resulted in a more critical perception of animal husbandry. Thus, it can be assumed that, due to their higher interest and knowledge, participants in cluster 1 have a firmer position on the subject matter. The lower estimation of costs in the first cluster and the belief that elements could be more easily installed/used compared to cluster 2 might be due to participants in this cluster prioritising the benefit to animal welfare over the costs or practicability and thus rated it more optimistically.

5. Conclusion

Citizens seem to appreciate various housing elements that enrich the pig's environment, but they differentiate between elements by rating some to be of greater benefit to animal welfare than others. Although near-natural enrichment elements (i.e. wallow, straw as bedding) were rated exceptionally positively, our results provide evidence that even smaller enrichment arrangements have the potential to meet citizens' acceptance (i.e. rooting area, showers, straw in containers), whereas simple enriching objects (i.e. plastic block, rubber hose, rope and wooden block) do not. Thus, even smaller animal welfare arrangements, which may be easier to implement but are nevertheless beneficial in terms of animal welfare, could be a promising opportunity for pig farmers to adapt their production systems to meet societal demands and to improve welfare. However, the fact that the benefit of all enriching elements (i.e. toys) to animal welfare does not seem to be obvious to laypersons, but needs to be explained, should be considered with regard to communication activities. Furthermore, citizens apparently have only

Appendix

Table A1

Principal component analysis: items assessing attitude towards animal protection/welfare. Rotated component matrix.

Items	Loadings		
	Factor 1	Factor 2	Factor 3
This idle talk about animal protection is getting on my nerves.	0.797		
There are much more important issues in the world to think about than animal protection.	0.737		
To be honest, I don't think too much about animal protection.	0.695		
I don't care about housing conditions of farm animals – they will die anyway.	0.670		
The subject Animal Protection/Animal Welfare in agriculture is important to me.	-0.593		
If animals need to die for our food production, they should at least have had a good life.	-0.530		
Consumers should care more about animal protection and buy products provided by more species-appropriate animal husbandry systems.	-0.528		
In modern agriculture, animals are allowed to live according to their species-appropriate behaviour patterns.		0.797	
Overall, modern animal husbandry is good - there are always black sheep.		0.713	
In Germany animals are sufficiently protected by legal regulations.		0.691	
Animals are not treated well in modern animal husbandry.		-0.678	
Nowadays, farm animals are treated better than in the past.		0.675	
In modern agriculture animals do not suffer unnecessarily.		0.650	
Compliance with regulations regarding animal protection should be controlled more strictly.			0.781
Farmers should do much more for animal protection by improving housing conditions.			0.771
Political parties should do much more for animal protection by introducing stricter regulations.			0.672
Variance explained (57.5 % total)	22%	20%	15.5%

N = 414; the higher the factor loading, the greater the correlation between the underlying factor and the respective item; named factors: factor 1: 'importance of animal welfare/protection', factor 2: 'rating of the current animal husbandry', factor 3: 'responsibility of policy and farmers'.

little knowledge about costs and practicability of installing enriching housing elements. This challenges communication of why it might be difficult to install some elements in existing stables that have proven to effectively enhance welfare levels but that are expensive to use.

The two citizen segments regarding attitudes towards animal protection and welfare found in this study, rated housing elements differently and also differed in terms of gender, meat consumption patterns, interest in agricultural topics, and self-perceived knowledge of animal husbandry. This indicates that different segment specific strategies might be a good option. All in all, the findings help farmers adapt their production systems to meet citizens' demands while increasing animal welfare.

6. Limitations and future research

The pictures used in this study were quite heterogeneous and showed pigs using enrichment elements in their stable environment. Therefore, we cannot rule out that these factors influenced participants' ratings of the housing elements. Subsequent research should provide more similar pictures and additionally address the comparison of interests and needs from other stakeholders, such as farmers and farm animals.

Author statement

Achim Spiller: Funding acquisition.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Table A2
Rating of the housing elements; comparison of means between the two clusters.

	Benefit to animal welfare and desire for presence		High costs		Easy to install/use			
	Mean ¹ (SD)		Mean ² (SD)		Mean ³ (SD)			
	Cluster 1	Cluster 2	Cluster 1	Cluster 2	Cluster 1	Cluster 2		
Outdoor area slatted floor	2.50 (1.07)	***	2.84 (0.97)	2.75 (1.10)	**	3.00 (0.99)	3.25 (1.13)	3.10 (1.02)
Outdoor area straw	4.19 (0.78)	**	3.96 (0.72)	2.26 (1.08)	***	2.82 (1.12)	4.05 (0.94)	* 3.83 (0.93)
Rooting area	4.27 (0.82)	*	4.09 (0.65)	2.08 (1.07)	***	2.62 (1.06)	4.06 (0.94)	** 3.80 (0.91)
Straw bedding	4.41 (0.78)	***	4.15 (0.70)	2.53 (1.30)	**	2.90 (1.18)	3.87 (1.10)	3.70 (1.00)
Straw basket	3.13 (1.09)		3.19 (0.88)	1.66 (0.73)	***	2.06 (0.94)	4.06 (1.03)	3.89 (0.93)
Rooting tower	3.49 (0.98)		3.44 (0.85)	2.14 (0.92)	**	2.45 (1.05)	3.88 (0.95)	** 3.64 (0.95)
Wooden block	2.91 (1.17)		3.03 (0.93)	1.51 (0.88)	***	1.94 (0.99)	3.99 (1.16)	* 3.74 (1.06)
Rope	2.88 (1.10)		3.04 (0.95)	1.39 (0.78)	***	1.80 (1.02)	4.15 (1.12)	** 3.83 (1.06)
Rubber hose	2.66 (1.10)		2.90 (0.88)	1.35 (0.59)	***	1.85 (0.95)	3.99 (1.23)	3.78 (1.08)
Plastic block	2.63 (1.10)	*	2.86 (0.93)	1.34 (0.59)	***	1.79 (0.92)	3.87 (1.26)	3.75 (1.10)
Outdoor shower	3.84 (0.88)	**	3.61 (0.79)	3.04 (1.02)	*	3.26 (0.97)	3.47 (1.04)	3.30 (0.95)
Indoor shower	3.80 (0.89)	**	3.56 (0.78)	2.89 (1.04)	**	3.16 (1.02)	3.55 (1.02)	** 3.30 (0.97)
Tub	3.25 (1.10)		3.14 (0.89)	2.16 (0.97)	***	2.64 (0.99)	3.55 (1.09)	* 3.34 (0.96)
Wallow	4.55 (0.75)	***	4.19 (0.82)	2.01 (1.28)		2.22 (1.14)	3.95 (1.17)	** 3.67 (1.08)

Cluster 1: n = 175; Cluster 2: n = 236; AW = Animal welfare; mean¹ = mean score of the calculated new variable 'benefit to AW and desire for presence' (CRA = \geq 0.9 for all housing elements) based on the mean ratings of the five items referring to the benefit the housing elements add to AW and the one referring to the desire for presence in a pigsty; mean² = average rating regarding the statement "costs associated with the installation/use of the housing elements are high"; mean³ = average rating of the housing elements regarding the statement "this housing element can be easily installed/used in any production system"; SD = standard deviation; 5-point Likert scale from 1 = completely disagree, 2 = rather disagree, 3 = partly disagree/partly agree, 4 = rather agree, 5 = totally agree; comparison of mean scores using ANOVA; asterisks mark significant differences between the two clusters with * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$.

Table A3
Sociodemographic characteristics of the participants in the two clusters.

		Cluster 1	Cluster 2	
Gender***	Female	62.9%	44.1%	
	Male	37.1%	55.9%	
Age groups n.s.	18-29	17.8%	16.9%	
	30-39	13.8%	14.0%	
	40-49	11.5%	18.2%	
	50-59	21.8%	17.4%	
	60+	35.1%	33.5%	
Place of residence n.s.	South ¹	30.9%	27.5%	
	North ²	12.6%	19.1%	
	East ³	18.3%	22.5%	
	West ⁴	38.3%	30.9%	
Education n.s.	No educational qualifications	3.4%	3.8%	
	Secondary school (low)	33.1%	30.9%	
	Secondary school (high)	26.3%	31.8%	
	Higher education entrance qualification	33.1%	29.7%	
	Still in education	4.0%	3.8%	
Household income n.s.	under 1.300 €	21.1%	19.9%	
	1.300-2.600 €	42.3%	36.9%	
	2.600- under 4.500	25.1%	33.5%	
	4.500 and more	11.4%	9.7%	
Urbanity of residence n.s.	Rural (under 5.000 habitants)	24.0%	25.4%	
	Urban (5.000- under 20.000 habitants)	18.3%	17.4%	
	Highly urban (20.000- under 100.000 habitants)	26.9%	25.0%	
	Extremely urban regions (more than 100.000 habitants)	30.9%	32.2%	
Pets	Grown up with pets	Yes/No	73.1% / 26.9%	67.4% / 32.6%
	Pet owner	Yes/No	56.0% / 44.0%	46.6% / 53.4%
	Desire for a pet*	Yes/No	58.4% / 41.6%	43.7% / 56.3%

(continued on next page)

Table A3 (continued)

	Cluster 1	Cluster 2
Meat and meat product consumption***		
Much and rather much	10.3% ^a	23.7% ^b
Average amount	32.6% ^a	45.8% ^b
Rather little and few	44.6% ^a	29.2% ^b
No meat or meat products except fish	4.6% ^a	0.8% ^b
Vegans or vegetarians	8.0% ^a	0.4% ^b

Cluster 1: n = 175; cluster 2: n = 236; Chi-square test with * = p < 0.05, ** = p < 0.01, *** = p < 0.001; n.s. = no significant differences a, b = significant differences (p < 0.05) between clusters according to z-test in the cross-tabulation.

¹ Bavaria, Baden-Wuerttemberg

² Bremen, Hamburg, Lower-Saxony, Schleswig-Holstein

³ Brandenburg, Berlin, Saxony, Saxony-Anhalt, Thuringia, Mecklenburg-Western Pomerania

⁴ Hessa, North Rhine-Westphalia, Rhineland-Palatinate, Saarland.

Table A4

Comparison of means regarding interest and self-perceived knowledge between the two clusters.

	Cluster 1 Mean (SD)	Cluster 2 Mean (SD)
Interested in		
Agriculture***	3.70 (0.94)	3.17 (0.93)
Pig husbandry***	3.63 (1.02)	2.96 (0.93)
Self-perceived knowledge of		
Pig husbandry***	2.97 (0.89)	2.58 (0.97)
Cattle husbandry**	2.86 (0.87)	2.56 (0.92)
Poultry husbandry***	3.03 (0.88)	2.67 (0.96)
Natural behavioural needs/patterns of pigs***	2.85 (0.86)	2.49 (0.85)

Cluster 1: n = 175; cluster 2: n = 236; SD = standard deviation; 5-point Likert scale for the rating of knowledge from 1 = extremely low, 2 = rather low, 3 = middle, 4 = rather high and 5 = extremely high and for interest from 1 = not at all, 2 = rather not, 3 = partly/partly, 4 = little, 5 = much; comparing of mean scores using ANOVA; significant differences between the two clusters with * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

References

- Backhaus, K., Erichson, B., Plinke, W., Weiber, R., 2008. In: Auflage (Ed.), Springer, Berlin, pp. 12.
- Barnett, J.L., Hemsworth, P.H., Cronin, G.M., Jongman, E.C., Hutson, G.D., 2001. A review of the welfare issues for sows and piglets in relation to housing. *Aust. J. Agric. Res.* 52, 1–28.
- Blokhuis, H.J., Veissier, I., Miele, M., Jones, B., 2010. The Welfare Quality® project and beyond: Safeguarding farm animal well-being. *Acta Agric. Scand. Sect. — Anim. Sci.* 60, 129–140.
- Blokhuis, H., Jones, B., Veissier, I., Miele, M., 2013a. Introduction. In: Blokhuis, H., Miele, M., Veissier, I., Jones, B. (Eds.), *Improving Farm Animal Welfare: Science and Society Working Together: The Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, pp. 13–17 Imprint: Wageningen Academic Publishers.
- Blokhuis, H., Veissier, I., Jones, B., Miele, M., 2013b. The Welfare Quality® vision. In: Blokhuis, H., Miele, M., Veissier, I., Jones, B. (Eds.), *Improving Farm Animal Welfare: Science and Society Working Together: The Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, pp. 71–89 Imprint: Wageningen Academic Publishers.
- Bloomsmith, M., Brent, L., Schapiro, S., 1991. Guidelines for developing and managing an environmental enrichment program for nonhuman primates. *Lab. Anim. Sci.* 41, 372–377.
- Boogaard, B., Boekhorst, L.J.S., Oosting, S., Sørensen, J., 2011. Sociocultural sustainability of pig production: Citizen perceptions in the Netherlands and Denmark. *Livest. Sci.* 140, 189–200.
- Boogaard, B.K., Oosting, S.J., Bock, B.B., 2006. Elements of societal perception of farm animal welfare: A quantitative study in The Netherlands. *Livest. Sci.* 104, 13–22.
- Boogaard, B.K., Oosting, S.J., Bock, B.B., 2008. Defining sustainability as a socio-cultural concept: Citizen panels visiting dairy farms in the Netherlands. *Livest. Sci.* 117, 24–33.
- Bornett, H.L.L., Guy, J.H., Cain, P.J., 2003. Impact of Animal Welfare on Costs and Viability of Pig Production in the UK. *J. Agric. Environ. Ethics* 16, 163–186.
- Bracke, M.B.M., Zonderland, J.J., Lenskens, P., Schouten, W.G.P., Vermeer, H., Spoolder, H.A.M., Hendriks, H.J.M., Hopster, H., 2006. Formalised review of environmental enrichment for pigs in relation to political decision making. *Appl. Anim. Behav. Sci.* 98, 165–182.
- Brade, W., Flachowsky, G., 2006. Schweinezucht und Schweinefleischerzeugung: Empfehlungen für die Praxis. Johann Heinrich von Thünen-Institut, Braunschweig.
- Bühl, A., 2010. SPSS 18. Einführung in die moderne Datenanalyse, 12. aktualisierte Auflage. ed. München.
- Bulens, A., Biesemans, C., Van Beirendonck, S., Van Thielen, J., Driessen, B., 2016. The effect of a straw dispenser on behavior and lesions in weanling pigs. *J. Vet. Behav.* 12, 49–53.
- Busch, G., Gaily, S., Spiller, A., 2017. Ich sehe was, was du nicht siehst: eine Eye-Tracking-Studie zur Betrachtung und Bewertung von Bildern aus der Schweinemast [An eye-tracking study to analyze and assess pictures of fattening pigs]. *Ger. J. Agric. Econ.* 66 (2), 65–84.
- Busch, G., Gaily, S., von Meyer-Höfer, M., Spiller, A., 2019. Does picture background matter? People's evaluation of pigs in different farm settings. *PLoS One* 14, e0211256.
- Cordts, A., Spiller, A., Nitzko, S., Grethe, H., Duman, N., 2013. Fleischkonsum in Deutschland. Von unbekümmerten Fleischessern, Flexitariern und (Lebensabschnitts-) Vegetariern. *Fleischwirtsch.* 7, 59–63.
- Duncan, I.J.H., 2005. Science-based assessment of animal welfare: farm animals. *Rev. Sci. Tech. Int. Off. Epizoot.* 24, 483–492.
- Duncan, I.J.H., 2002. Poultry welfare: Science or subjectivity? *Br. Poult. Sci.* 43, 643–652.
- Eurobarometer, 2016. **Special Eurobarometer 442: Attitudes of Europeans towards Animal Welfare**. https://data.europa.eu/euodp/de/data/dataset/S2096_84_4_442_ENG (accessed 11.15.17).
- European Food Safety Authority, 2007. Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets - Scientific Opinion of the Panel on Animal Health and Welfare. *EFSA J.* 572, 1–13.
- FAWC, 1992. Farm animal welfare council: FAWC updates the five freedoms. *Vet. Rec.* 131, 357.
- Fraser, D., Duncan, I.J.H., Edwards, S.A., Grandin, T., Gregory, N.G., Guyonnet, V., Hemsworth, P.H., Huertas, S.M., Huzzey, J.M., Mellor, D.J., Mench, J.A., Spinka, M., Whay, H.R., 2013. General Principles for the welfare of animals in production systems: the underlying science and its application. *Vet. J.* 198, 19–27.
- Fraser, D., Weary, D.M., Pajor, E.A., Milligan, B.N., 1997. A scientific conception of animal welfare that reflects ethical concerns. *Anim. Welf.* 6, 187–205.
- Frewer, L.J., Kole, A., Kroon, S.M.A.V.de, Lauwere, C.de, 2005. Consumer Attitudes Towards the Development of Animal-Friendly Husbandry Systems. *J. Agric. Environ. Ethics* 18, 345–367.
- Hair, J.F., Anderson, R.E., Tatham, R.L., 1998. *Multivariate data analysis*. Prentice-Hall, Upper Saddle River, NJ [u.a.].
- Hare, V.J., Sevenich, M., 2001. Is it training or is it enriching? *Proc. Fourth. Int. Conf. Env. Enrich* 40–47.
- Harper, G., Henson, S., 2001. Consumer Concerns about Animal Welfare and the Impact

- on Food Choice. Final Report EU Fair CT98-3678, Centre for Food Economics Research, University of Reading.
- Hsia, L.C., Fuller, M.F., Koh, F.K., 1974. The effect of water sprinkling on the performance of growing and finishing pigs during hot weather. *Trop. Anim. Health Prod.* 6, 183–187.
- Huynh, T.T.T., Aarnink, A.J.A., Truong, C.T., Kemp, B., Verstegen, M.W.A., 2006. Effects of tropical climate and water cooling methods on growing pigs' responses. *Livest. Sci.* 104, 278–291.
- Kaiser, H.F., Rice, J., 1974. Little Jiffy. *Mark IV. Educ. Psychol. Meas.* 34, 111–117.
- Kayser, M., Böhm, J., Spiller, A., 2012a. Zwischen Markt und Moral. Wie wird die deutsche Land- und Ernährungswirtschaft in der Gesellschaft wahrgenommen? *Schriften Ges. Für Wirtsch.- Sozialwissenschaften Landbaus E V* 329–341.
- Kayser, M., Schlieker, K., Spiller, A., 2012b. Die Wahrnehmung des Begriffs „Massentierhaltung“ aus Sicht der Gesellschaft. *Berichte über Landwirtschaft* 90 (3), 417–428.
- Keeling, L., Evans, A., Forkman, B., Kjaernes, U., 2013. Welfare Quality® principles and criteria, in: Blokhuys, H., Miele, M., Veissier, I., Jones, B. (Eds. *Improving Farm Animal Welfare : Science and Society Working Together: The Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, pp. 91–114 Imprint: Wageningen Academic Publishers.
- Kendall, H.A., Lobao, L.M., Sharp, J.S., 2006. Public Concern with Animal Well-Being: Place, Social Structural Location, and Individual Experience*. *Rural Sociol.* 71, 399–428.
- Kijlstra, A., Eijck, I.A.J.M., 2006. Animal health in organic livestock production systems: a review. *NJAS - Wagening. J. Life Sci.* 54, 77–94.
- Krystallis, A., Barcellos, M.D.de, Kügler, J.O., Verbeke, W., Grunert, K.G., 2009. Attitudes of European citizens towards pig production systems. *Livest. Sci.* 126, 46–56.
- Lassen, J., Sandøe, P., Forkman, B., 2006. Happy pigs are dirty! – conflicting perspectives on animal welfare. *Livest. Sci. Ethics Anim. Agricult.* 103 221–230.
- María, G.A., 2006. Public perception of farm animal welfare in Spain. *Livest. Sci.* 103, 250–256.
- McKendree, M.G.S., Croney, C.C., Widmar, N.J.O., 2014. Effects of demographic factors and information sources on United States consumer perceptions of animal welfare. *J. Anim. Sci.* 92, 3161–3173.
- Meyer-Hamme, S., Lambert, C., Gauly, M., 2018. Assessing the welfare level of intensive fattening pig farms in Germany with the Welfare Quality® protocol: does farm size matter? *Anim. Welf.* 27, 275–286.
- Miele, M., Blokhuys, H., Bennett, R., Bock, B., 2013. Changes in farming and in stakeholder concern for animal welfare, in: *Improving Farm Animal Welfare*. Wageningen Academic Publishers, Wageningen, pp. 19–47.
- MRI (Max Rubner-Institut, Bundesforschungsinstitut), 2008. *Nationale Verzehrsstudie II Ergebnisbericht*.
- Newberry, R.C., 1995. Environmental enrichment: Increasing the biological relevance of captive environments. *Appl. Anim. Behav. Sci.* 44, 229–243.
- Rovers, A., Christoph-Schulz, I., Brümmer, Nanke, Saggau, D., 2017. Trust no One? Citizens' Concerns regarding the Pork and Dairy Supply Chain. *Proc. Food Syst. Dyn.* 0, 87–93.
- Sambrabus, H.H., 1991. *Nutztierkunde*. Ulmer, Stuttgart.
- Shepherdson, D.J., 1994. The role of environmental enrichment in the captive breeding and reintroduction of endangered species, in: Mace, G., Olney, P., Feistner, A.T.C. (Eds. *Creative Conservation: Interactive Management of Wild and Captive Animals*. Chapman & Hall, London, pp. 167–177.
- Shamon, H., Berning, C.C., 2020. Attention Check Items and Instructions in Online Surveys with Incentivized and Non-Incentivized Samples: Boon or Bane for Data Quality? *Surv. Res. Methods* 14, 55–77.
- Spoolder, H.A., 2007. Animal welfare in organic farming systems. *J. Sci. Food Agric.* 87, 2741–2746.
- Statistisches Bundesamt, 2011. *Wer produziert unsere Lebensmittel? Aktuelle Ergebnisse aus der Landwirtschaftszählung 2010*. Wiesbaden. https://www.destatis.de/ GPStatistik/servlets/MCRFileNodeServlet/DEMonografie_derivate_00001484/WerProduziertNahrungsmittel.pdf?jsessionid=76A1009DDC3A3F7FD2DB5621AE562B43 (accessed 12.19.19).
- Sundrum, A., 2001. Organic livestock farming: A critical review. *Livest. Prod. Sci.* 67, 207–215.
- Tuytens, F.A.M., 2005. The importance of straw for pig and cattle welfare: A review. *Appl. Anim. Behav. Sci.* 92, 261–282.
- van de Weerd, H.A., Day, J.E.L., 2009. A review of environmental enrichment for pigs housed in intensive housing systems. *Appl. Anim. Behav. Sci.* 116, 1–20.
- van de Weerd, H.A., Docking, C.M., Day, J.E.L., Edwards, S.A., 2005. The development of harmful social behaviour in pigs with intact tails and different enrichment backgrounds in two housing systems. *Anim. Sci.* 80, 289–298.
- van de Weerd, H.A., Ison, S., 2019. Providing Effective Environmental Enrichment to Pigs: How Far Have We Come? *Animals* 9, 254.
- Verbeke, W., 2009. Stakeholder, citizen and consumer interests in farm animal welfare. *Anim. Welf.* 18, 325–333.
- Webster, A.J., 2001. Farm animal welfare: the five freedoms and the free market. *Vet. J.* 161, 229–237.
- Weible, D., Christoph-Schulz, I., Salamon, P., Zander, K., 2016. Citizens' perception of modern pig production in Germany: a mixed-method research approach. *Br. Food J.* 118, 2014–2032.
- Wildraut, C., Plesch, G., Ziron, M., Mergenthaler, M., Härten, I., Simons, J., Hartmann, M., 2015. Multimethodische Bewertung von Schweinehaltungsverfahren durch Verbraucher anhand von Videos aus realen Schweineställen. *Fachhochschule Südwestfalen Fachbereich Agrarwirtschaft*. Soest.
- Young, R.J., 2003. *Environmental enrichment for captive animals*. UFAW animal welfare series. Blackwell Science, Oxford, UK.
- Zander, K., Isermeyer, F., Bürgelt, D., Christoph-Schulz, I.B., Salamon, P., Weible, D., 2013. *Erwartungen der Gesellschaft an die Landwirtschaft*. Stiftung Westfälische Landschaft, Münster.