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**New methods of increasing transparency: Does
viewing webcam pictures change peoples'
opinions towards modern pig farming?**

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New methods of increasing transparency: Does viewing webcam pictures change peoples' opinions towards modern pig farming?

Abstract

Public interest in livestock farming is increasing, as is general criticism regarding the welfare of farm animals. In this context, husbandry systems for pigs especially are perceived very negatively. Despite rising concern for animal farming, most people lack detailed knowledge of modern agricultural production processes, as well as direct contact with agriculture. With regards to public demand for transparency of production quality and animal welfare standards, farmers and farmer associations in several countries have begun installing webcams in dairy, pig and poultry farming operations. Along with informational texts, pictures from webcams are publicly available on the internet and are used as a new type of communication tool aimed at increasing the acceptance of livestock farming by providing farming-specific information. However, there are currently no existing studies quantitatively investigating the effect of webcam pictures from stables and accompanying informational texts on the broader public. In a randomized between-subject experimental design, we presented two webcam pictures from conventional pig barns (pig fattening barn and sow farrowing pen) to the broader public, along with two different informational texts (one written directly by farmers and one neutrally written by the authors). Therefore, the objective of this study is to examine 1) if the attitude towards pig farming changes after having seen the webcam pictures, 2) if different informational texts alter the evaluation of webcam pictures, 3) if there are differences in the perception of webcam pictures of a pig fattening barn and a sow farrowing pen, and 4) how people evaluate the use of webcams as a public relations tool that can be used to provide transparency. It was determined that the majority of respondents display a more negative attitude after viewing the webcam pictures and informational texts, and this is especially true for participants reading the neutrally written texts. Further, the farrowing pen is evaluated substantially more negatively than the pig fattening pen. Regarding the overall evaluation of webcams, people seem to appreciate that farmers show real pictures from their stables, although a rather low interest in the usage of webcams in agriculture can be observed. Thus, although transparency may be enhanced through the use of webcams, our findings suggest that webcams generally do not show the desired effects on the public and are likely to be unable to improve the image of pig farming by simply providing information via pictures and

texts. Finally, the application of webcams as a communication tool cannot be recommended, at least not for the husbandry systems investigated within this study.

Keywords: Pig farming, webcam, transparency, attitude change, image, communication tool

1 Introduction

Public concern regarding the welfare of farm animals has greatly increased in recent years (e.g., Appleby, 1999; Lassen et al., 2006; Botreau et al., 2007; Tawse, 2010; Boogaard et al., 2011a; Vanhonacker and Verbeke, 2014; Ryan et al., 2015) and growing interest in modern food production processes is evident (Grunert, 2005; Verbeke, 2005; Tonsor et al., 2009; Caracciolo et al., 2016). Thus, the need for visual representation of production processes increased due to the demand for transparency of production quality and animal welfare (Blokhuys et al., 2003). To enhance transparency and general acceptance of livestock farming, researchers propose approaches for farmers to give insight into modern food production in a proactive, transparent and comprehensive way, for example through the use of webcams in pig barns, in order to mitigate public distrust (Spiller, 2013; Zander et al., 2013).

Indeed, farmers and farmer associations in some European countries have begun promoting campaigns through social networks and on webpages in order to provide videos and webcams that realistically show livestock and their living conditions to increase transparency for the public (LBV Baden-Württemberg, 2013). According to sources in the communication science field, visual transparency implies the provision of information that is typically unavailable or unknown by other people, which creates trust (van Woerkum and Aarts, 2009). The provision of visual information may therefore be useful in convincing the public of the reliability of, e.g., an organization (van Woerkum and Aarts, 2009). Thus, the use of automated cameras especially is critical for authentically representing reality (van Woerkum and Aarts, 2009) and is a relatively new tool for advocating transparency that has a chance of enhancing public trust in the agricultural sector. Therefore, webcams which record daily life in cattle, dairy, pig and poultry farming operations have been established in some countries, to provide visual insight into daily work processes, while thoroughly explaining such processes via informational texts. For example, Peter's Farm (www.petersfarm.com), which is a brand of the market leading VanDrie Group, provides insight into the lives of calves in loose housing systems in the Netherlands via webcams.

In Germany, the first webcam used to officially record pictures of a pig barn was installed in 2013 by Werner Schwarz, vice president of the German Farmers' Association. He made the webcam pictures of his farrowing pen accessible to the public on the website of the farmer association of Schleswig-Holstein¹ (Topagrar, 2013); this approach gained much public attention, evoking both positive and negative reactions. Schwarz thereby aimed at meeting

¹Website: <http://www.bauern.sh/die-webcams/die-webcam-aus-dem-sauenstall-von-werner-schwarz.html>

consumers' need to better understanding food production by increasing the degree of knowledge and acceptance regarding food production operations (Topagrar, 2013). In 2015, the German Farmers' Association decided that every federal state in Germany should provide insight into modern pig farming through at least one webcam in a pig barn (Focus Online, 2015).

The application of webcams is also known from other fields. For example, webcams can be used to measure animals' behavior in experiments (Tort et al., 2006), as well as monitor different parameters regarding animals' well-being in veterinary clinics (e.g., Silva, 2011) and on farms (e.g., Oltjen and Ahmadi, 2005; Kollis et al., 2007; Kashisha et al., 2013). Further, they can be installed as outdoor cameras by governments, companies, conservation societies, national parks, universities or private citizens to advertise specific areas (Jacobs et al. 2009) or to report traffic or weather conditions, for example as map supplements (Monmonier, 2000). Moreover, they provide insight into animals' natural behaviors in the wild at specific locations (Jacobs et al., 2009; Kamphof, 2013), into zoo animals' lives (Clay et al., 2011), and into monitoring plant life (Richardson et al., 2007; Jacob et al., 2009). Thus, especially in the field of tourism and zoos, webcams are used as public relations tools (Jacobs et al., 2009). However, to our best knowledge, there are no existing studies which measure the effect of these webcams on the public, despite necessity for such evaluations. Clay et al. (2011), for example, emphasize the importance of assessing the effect of webcams in zoos on the knowledge and conservation-oriented attitudes of visitors.

Again, for the field of livestock farming especially, no studies investigate the effect of webcam pictures of stables and accompanying informational texts on the broader public quantitatively. We will later discuss one study which qualitatively measured the perception of webcam pictures.

By utilizing webcams, the aim of promoting trust in modern agricultural production processes could be achieved by combining a transparency approach with contributing information, thus enhancing public knowledge and image of pig farming. The objective of this study is therefore to determine whether information displayed through webcam pictures and informational texts change peoples' attitude towards pig farming, along with whether the provision of visual transparency is positively perceived. Thereby we use a randomized between-subject experimental design (Charness et al., 2012). We used webcam pictures from pig barns as an example, as pig farming is especially criticized by the public, and offers the most practical examples of webcam applications.

2 Public attitude towards pig farming and the capabilities of webcams

Regarding living conditions for farm animals, the majority of modern husbandry systems are widely criticized (e.g., Zander et al., 2013; Vanhonacker and Verbeke, 2014; Busch et al., 2015a; 2017; Spiller et al., 2015) and husbandry conditions for pigs especially are negatively perceived by the general public (Boogaard et al., 2011a; Zander et al., 2013; Spiller et al., 2015). Specific criticism is focused on the limited space in pig barns (e.g., Te Velde et al., 2002; Boogaard et al., 2011a; Zander et al., 2013; Wildraut et al., 2015) and the lacking possibility for pigs to realize species-specific behavior (e.g., Te Velde et al., 2002; Lassen et al., 2006; Boogaard et al., 2011a). Furthermore, gestation and farrowing crates for the keeping of sows are viewed particularly negatively by the public (Tonsor et al., 2009; Tonsor and Wolf, 2011; Ryan et al., 2015; Möstl and Hamm, 2016; Sonntag et al., 2017), while the restriction of sows' freedom of movement is especially condemned by the public (Rhodes et al., 2005; Tonsor et al., 2009; Sonntag et al., 2017).

Despite general criticism regarding the conditions of modern pig farming, the public is generally deemed to have only limited knowledge about livestock farming and animal welfare conditions (Te Velde et al., 2002; Vanhonacker et al., 2008; Vanhonacker and Verbeke, 2014; Ryan et al., 2015). Most citizens lack direct contact and experience with farm animals (Boogaard et al., 2011a; Busch et al., 2015a; 2017) and are mainly informed about agricultural topics through mass media sources (TNS Emnid, 2012; Kantar Emnid, 2017). Public distrust is driven by rather negative pictures of farm animal welfare that circulate in the media (TeVelde et al., 2002; Vanhonacker et al., 2008), as well as by the common opinion that farmers could be concealing something due to production processes and livestock farming being mostly invisible to the general public (Zander et al., 2013). Thus, undercover filming of animal farms has become popular among animal activist groups in an attempt to investigate animal welfare conditions and portray perceived animal cruelty to the public (Tiplady et al., 2015; Robbins et al., 2016). In response, e.g., in the United States, livestock industries have defended themselves and so-called 'ag-gag' laws have been introduced. Such laws have already been passed in some states (Marceau, 2015; Robbins et al., 2016) with the intent of prohibiting the taking of pictures and recording of videos on farms without permission (Shea, 2014). Robbins et al. (2016) showed that public awareness of these 'ag-gag' laws have led to increased distrust in farmers by participants in a survey, suggesting that even the intention of limiting the availability of information may diminish trust. Thus, it is especially important to

find a way of communicating with the public and to provide transparent information (Spiller et al., 2013; Zander et al., 2013).

With respect to the objectives of webcam usage, however, it is unclear whether providing more knowledge about livestock farming will truly lead to greater public acceptance (Zander et al., 2013; Spiller et al., 2015; Möstl and Hamm, 2016). Studies have shown, for instance, that realistic pictures of livestock farming are perceived rather negatively (Busch et al., 2015a; 2017; Wildraut et al., 2015) and that better informed consumers tend to be even more critical towards agricultural processes than their lesser informed counterparts (Kayser et al., 2012; Zander et al., 2013; Ryan et al., 2015; Spiller et al., 2015). In general, the question of whether more information lead to greater acceptance is discussed in several fields within the framework of the information deficit hypothesis, which assumes that increased literacy among the public enhances public support, e.g., for scientific research (Scheufele, 2014). Communication researchers are, however, critical towards this thesis (Scheufele, 2014). Therefore, it remains unclear whether webcams are a useful communication tool to improve the contested image of modern animal husbandry.

To our best knowledge, there is only one existing study that has investigated the effect of webcam pictures on people thus far: In qualitative interviews, Möstl and Hamm (2016) showed two selected webcam pictures of a pig fattening barn as well as parts of the original website containing an informational text and a picture of the farmer to 21 participants. It was determined that, with regards to overall evaluation, although people appreciated the farmer's effort to increase transparency, viewing the webcam pictures did evoke negative evaluations for nearly half of the respondents. The lack of space and the pigs being kept on a slatted floor were especially criticized. Moreover, with respect to overall acceptance of pig farming, no change in acceptance was found for the interviewed respondents (Möstl and Hamm, 2016).

Although the present study gives first insight into the effects of webcam pictures on the public, it does not provide quantitative or representative data regarding how people evaluate webcam pictures and how their attitudes change from viewing such pictures. Thus, on the basis of the preliminary results of Möstl and Hamm (2016), we surveyed 508 German citizens, with set quotas for gender, age, income and education, in order to obtain representative data. Furthermore, the approach of Möstl and Hamm (2016) was expanded by also showing a webcam picture of a sow farrowing pen and by comparing the effects of different informational texts supporting the pictures. In our study, participants were presented with two pictures from webcams in two different German pig barns – one picture of a pig

fattening barn and one picture of a sow farrowing pen – accompanied by informational texts. We hereby quantitatively measure 1) if the attitude towards pig farming changes after having seen the webcam pictures, 2) if different informational texts alter the evaluation of webcam pictures, 3) if there are differences in the perception of webcam pictures of a pig fattening barn and a sow farrowing pen, and 4) how people evaluate the use of webcams as a public relations tool that can be used to provide transparency. The study aims to give greater insight into the process of public perception of presented webcam pictures complemented with informational texts. The results may have implications for the agricultural sector on how to use this new communication tool in order to increase transparency and acceptance of modern husbandry systems, especially pig farming.

3 Material and Methods

3.1 Participant recruitment and data collection

The current study was conducted via an online survey with 554 German citizens in June 2016 using an online access panel provider (Respondi AG). Quotas were set during data collection with respect to gender, age, education and income, in an effort to achieve representativeness for the German population. To ensure that all participants thoroughly read all questions within the survey, a quality control question was incorporated into the survey by simply asking participants to select the answer requested (e.g., ‘Please select ‘I rather disagree’’). Respondents that did not complete the survey or failed to answer the quality control question were removed. Furthermore, participants who completed the survey in less than half of the average response time, as well as straightliners (Zhang and Conrad, 2014) were excluded from the dataset. At the end of the data collection process, 508 participants remained for analysis.

3.2 Survey design

The sample was randomly split into two sub-samples (randomized between-subject experimental design (Charness et al., 2012); see Figure 1): One split was presented with the two webcam pictures (one picture of a pig fattening pen and one picture of a farrowing pen), along with the original texts (as presented with the webcam pictures on the original websites) written by the farmers. The second split was presented with the same pictures accompanied by texts written by the authors of the current study in a neutral style, but containing approximately the same information. The survey consisted of three main parts (see Figure 1): In the first part, participants were asked for information pertaining to their sociodemographic data, their connection to agriculture and their personal meat consumption. Furthermore,

respondents' attitudes towards pig farming was sampled using eight statements (attitude towards pig farming before webcam pictures, see Figure 1). Responses were given on a five-point Likert scale from +2 ('I totally agree') to -2 ('I totally disagree'). The second part represented the main section of the survey, where the webcam pictures and the corresponding texts were presented. The order of the webcam pictures was randomized for each sample split (either the picture of pig fattening or farrowing pen were shown first). After viewing each of the two webcam pictures, participants were asked to evaluate the pictures. The eight statements available for the evaluation of the pictures were the same as the statements used in the first part of the survey when participants were asked about their attitude towards pig farming, but adjusted to the corresponding pig barn. Thus, the statement from the beginning "Pigs are not doing fine in modern pig barns" was changed to "The pigs are not doing fine in this pig barn". In the final part of the survey, participants were requested to estimate the effect of the webcam pictures on their impression of modern pig barns given the statement "Do you think that your impression of a modern pig stable has become more positive or more negative than before?" (subjective attitude change after seeing webcam pictures, see Figure 1). Furthermore, respondents were asked to state their attitude towards pig farming again, after having seen the webcam pictures and texts (attitude towards pig farming after webcam pictures, see Figure 1), with the same statements evaluated in the beginning and after viewing each of the pictures again (attitude towards pig farming before webcam pictures). The use of the same statements at four different times throughout the survey allowed for a better comparison of participants' attitudes towards pig farming during the course of the survey. Finally, the survey was concluded with an overall evaluation of using webcam pictures and informational texts in agricultural communication.

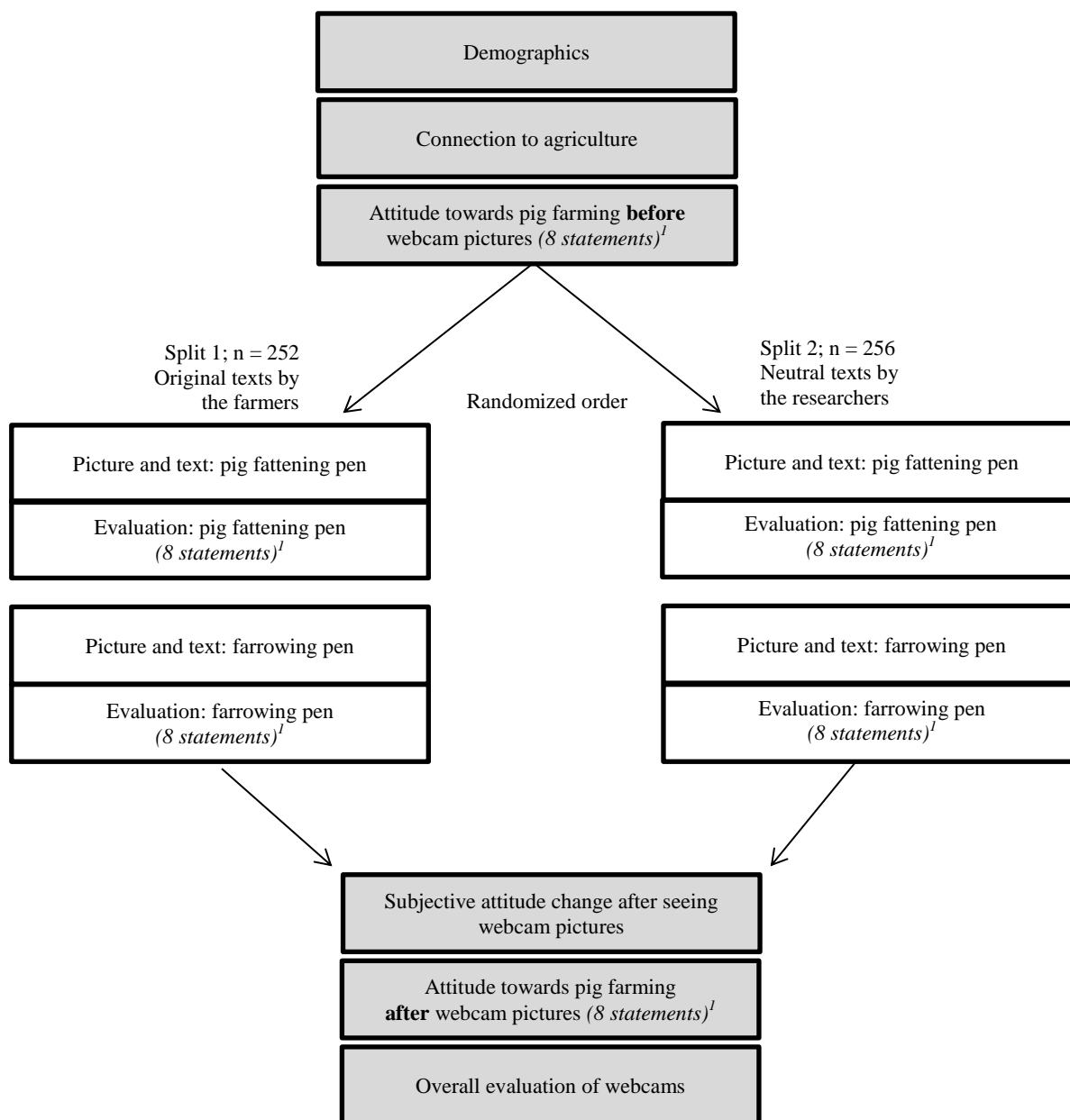


Figure 1. Survey design and sample splits. The parts of the survey which were identical for both sample splits are shown in gray. The order of webcam pictures (pig fattening or farrowing barn) was randomized for each split. ¹These eight statements are the same; for the evaluation of the pig fattening and the farrowing pens, these statements are adjusted to the particular pig barn, e.g., the statements “Pigs are not doing fine in modern pig barns” is changed to “The pigs are not doing fine in this pig barn.”

Source: own presentation

3.3 Webcam pictures

For this study, two snapshots taken by a webcam in a conventional pig fattening pen (Hessischer Bauernverband e. V., 2017) and in a conventional farrowing pen in Germany (Müllerhof Egenhofen, 2017) were chosen. Both pictures represented common husbandry practices in conventional German pig farming. The respective farmers granted permission for the use of the pictures for the online survey. Due to copyright-related reasons, the original webcam pictures are not displayed here. Figure 2 shows a picture of a pig fattening pen (Figure 2a) and a picture of a farrowing pen (Figure 2b) which are very similar to the original webcam pictures with respect to camera angle, perspective, brightness, pen conditions and number of animals.



a.



b.

Figure 2. Pictures similar to original webcam pictures. a. Snapshot showing pig fattening pen. b. Snapshot showing farrowing pen with sows and piglets.

Source: © Landpixel (Christian Mühlhausen)

3.4 Informational texts

For split 1, the webcam pictures were displayed as presented (see Figure 2) on the original website with the corresponding informational texts provided by the farmers, as well as a picture of the farmer, if available (only in case of the presentation of the pig fattening pen). Split 2 saw the same original webcam pictures, but was instead presented with an informational text written by the authors of this study in a neutral, shorter way, while containing approximately the same information as the original texts. For the neutral texts, all information from the original texts in relation to the farmers were excluded. At the beginning of the main part of the survey, participants were given a short introduction, in which they were explained that they would be shown a webcam picture of a pig fattening pen (or farrowing pen, respectively) on the next page; respondents were then asked to carefully view the pictures and to read the corresponding texts. Furthermore, one sentence explained the

meaning of a pig fattening pen and farrowing pen, respectively. In the following, the presented informational texts are provided.

Pig fattening pen: For split 1, the original text provided by the farmer for the webcam picture of the pig fattening pen reads as follows (rough translation, names are eliminated):

“[...] Here, at farmer X’s pig barn the pigs live in groups with approximately 40 animals (according to pen) in a bright and well-ventilated barn providing toys [...], feed [...], and of course water [...]. The pigs can divide the pen into different areas for themselves; there is an area for defecating, playing, lying down and feeding. The pigs are fed thirteen times per day to make sure that even low ranking animals receive feed. Daily controls and animal monitoring are an essential part of farmer X’s work. The pigs are brought to the farm as piglets and normally stay in the same group in the same pen until they are sold, approximately four months later. Farmer X uses the webcam to give insight into the daily life of his pigs, along with his daily routines [...] (website pig fattening pen, Hessischer Bauernverband e. V., 2017).”

Split 2 was given the information text for the pig fattening pen written in a neutral way by the authors (rough translation):

“Here you see a pig fattening pen. The pigs live in groups with approximately 40 animals in the pens, as can be seen in the picture, and can divide the pen into different areas for themselves. There are areas for defecating, playing, lying down and feeding. The pigs are fed thirteen times per day, water and toys [...] are available for the animals at any time. The pigs are brought to the farm as piglets and stay in the same group until they are sold approximately four months later (neutral text by the researchers based on the informational text by Hessischer Bauernverband e. V., 2017).”

Farrowing pen: For the webcam picture of the farrowing pen, the following (original) text written by the farmer was presented to participants in split 1 (rough translation):

“[...] As soon as the light in the barn is turned off, the webcam does not take pictures anymore. While farrowing, I monitor the birthing process 24 hours. During this time, the light is turned on and you can observe the farrowing process day and night. The mother sows stay in the farrowing pen for 21 days; they are brought to the farrowing pen four days before giving birth to settle in [...]. The metal cage, which may look terrible to you, is called a farrowing crate and prevents the piglets from being crushed by her mother. [...] Regarding the use of these crates, the fixation of the sows for a distinct time is compulsory in Germany to protect the farmer. I am planning to establish group housing for the sows, where they can move freely, because I do not like the look of farrowing crates anymore. Because of low prices for the piglets, it is not possible to realize group housing for sows at the moment. As of today, I would be planning the pig barn, which I had built according to the current regulations in 2010, exclusively for group housing (website sow farrowing pen, Müllerhof Egenhofen, 2017).”

The neutral text (split 2) written by the authors of this study was formulated as follows (rough translation):

“Here, you see a webcam picture of a so-called farrowing pen of a sow management system. In a sow management system, the mother sow is kept together with the piglets. The sows stay in the farrowing pen for 21 days; they are brought to the farrowing pen four days before giving birth to settle in. The piglets are sold later for the production of meat. The sow is lying in a so-called farrowing crate (the metal cage in the picture); this is to prevent the sow from crushing the piglets (neutral text by the researchers based on the informational text by Müllerhof Egenhofen, 2017).”

3.5 Data analysis

Data was analyzed using IBM SPSS Statistics 23. The differences in the socio-demographic data between the two splits were analyzed using cross tabulations and Chi-square tests. Paired t-tests were then used to compare the evaluation of the pig fattening pen and the farrowing pen within the splits. Furthermore, independent t-tests were conducted to test for differences in the attitude towards pig farming between the two splits before and after having viewed the webcam pictures and read the texts. The change in attitude before and after seeing the webcam pictures was calculated individually for both sample splits. Using the differences between the mean indices of the eight statements before and after viewing the webcam pictures for each respondent, different groups related to attitude change were defined for the whole sample. Seven groups were established, according to differentiations in the net shifting of points on the Likert scale (either towards more positive or more negative attitude; a point difference of 0 indicates no change, while the range between 1 and 8 or more points indicate more negative or more positive attitudes after viewing webcam pictures). Pearson correlations were used to test for correlations between the subjective change in attitude (question “Do you think that your impression of a modern pig stable has become more positive or more negative than before?”) and objective change in attitude (determined through different groups).

Further, we conducted two factor analyses using Varimax rotation in order to condense statements for comparisons between the seven different groups related to attitude change: The eight statements regarding the attitude towards pig farming after viewing the webcam pictures and informational texts were condensed into one factor (Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) = 0.91, total variance explained = 65.95%, Cronbach’s Alpha (CA): 0.93; Table AI in Appendix). Moreover, a second factor analysis was conducted to condense the six statements regarding the overall evaluation of webcams (KMO = 0.77, total variance explained = 67.01%; Table AII in Appendix). Through this analysis, two factors could be identified: One reliable factor of interest in webcams containing four statements (CA: 0.82) and a second factor regarding disbelief in image increase through webcams, showing a smaller Cronbach’s Alpha (CA: 0.54); the smaller value for Cronbach’s Alpha

could partially be explained by the fact that this factor only contains two statements; nevertheless, we decided to use this factor for further analysis. We used the three extracted factors (Factor “Attitude towards pig farming after webcam pictures” from first factor analysis; Factor 1 “Interest in webcams” and Factor 2 “Disbelief in image increase through webcams” from second factor analysis) for investigating differences between the seven groups related to attitude change: Analysis of variance was conducted to examine differences between the group means for the three factors.

4. Results

4.1 Sample description

According to the four quotas set for data collection, the distribution of gender, age, income and education in the current study is very close to the actual distribution of the German population (see Table 1). With respect to socio-demographic data and connection to agriculture, no significant differences ($p > 0.05$, Chi-square test) were found between the two established splits.

In split 1, 0.8% (0.0% in split 2) of participants stated that they worked in the field of agriculture, 4.0% (6.6%) grew up on a farm. 6.7% (6.3%) of the respondents said that a family member worked in an agricultural business. 0.8% (1.2%) stated that they had absolved an agricultural education. Regarding agricultural contact, 18.7% (20.7%) are regularly in contact with agriculture through friends and hobbies, 30.2% (22.7%) often do shopping in a farm shop. 55.6% (54.3%) indicated that they had no connection to agriculture. In split 1, 93.3% of respondents (91.8% in split 2) indicated that they had never or rarely visited a pig stable. Regarding the source of agricultural information utilized by participants, 27.8% (21.9%) often or very often use newspapers, 44.5% (37.5%) television, 33.3% (28.1%) internet, 10.7% (8.6%) magazines, 16.3% (12.1%) radio and 6.8% (7.5%) other sources of information. When asked about their knowledge of webcams in stables, 88.1% in split 1 (92.5% in split 2) indicated that they had never or rarely seen webcam pictures of pig barns before (3.2% (7.5%) occasionally, often or very often). Regarding webcam pictures from other types of animal farms, 86.5% (89.5%) stated that they had never or rarely seen such pictures (5.2% (10.5%) occasionally, often or very often). In the first split, 7.1% are vegetarians (6.3% in split 2), while 73.8% (71.1%) eat meat regularly, on a daily basis or several times per week.

Table 1. Sample description showing the distribution of demographics in the two sample splits.

Quota	Specification	Split 1 (Original texts)	Split 2 (Neutral texts)	German population
Gender ¹	Male	48.4%	50.8%	49.0%
	Female	51.6%	49.2%	51.0%
Age ¹	16-29	20.2%	19.1%	18.7%
	30-49	28.6%	31.2%	31.3%
	50+	51.2%	49.2%	50.0%
Net household income per month ¹	< 1,300€	26.6%	23.8%	23.7%
	1,300 to 2,599€	38.5%	38.7%	38.6%
	2,600 to 4,499€	25.4%	26.2%	26.0%
	> 4,500€	9.5%	11.3%	11.8%
Education ¹	No graduation (yet)	6.3%	6.6%	7.1%
	Completion of compulsory basic secondary schooling	35.3%	35.5%	32.9%
	General Certificate of Secondary Education	29.0%	28.5%	29.4%
	General qualification for university entrance	13.1%	13.7%	14.3%
	University degree	16.3%	15.6%	16.3%

¹No significant differences between the two splits.

Source: Statistisches Bundesamt (2015a), Statistisches Bundesamt (2015b); own calculations

4.2 Change in attitude towards pig farming in both sample splits

A change in attitude towards pig farming after having seen the webcam pictures cannot be determined for split 1 participants who received the original texts (Table 2). Only means for the statement “Pigs are not doing fine in modern pig barns” at the beginning of the survey differ from means at the end of the survey with a more positive attitude being found after having seen the webcam pictures and informational texts. Correlations between the means for the evaluation before and after seeing the webcam pictures are moderate, indicating that respondents were rather uncertain with respect to their own evaluation.

Table 2. Comparison of means between the attitude towards pig farming at the beginning and the end of the survey (after webcam pictures) for split 1 (original texts)

Statement	Mean before webcam pictures (SD)	Mean after webcam pictures (SD)	Correlation	t-value
Pigs are not doing fine in modern pig barns.	0.52 (0.98)	0.33 (1.10)	0.48***	2.78**
Farmers take good care of their pigs.	0.04 (0.79)	0.10 (0.93)	0.42***	-1.01
Pigs can live according to their natural behavior in modern pig barns.	-0.75 (1.00)	-0.74 (1.03)	0.45***	-0.06
Pigs do not have enough space in modern pig barns.	0.77 (1.04)	0.72 (1.13)	0.42***	0.64
I think pictures from pig barns are terrifying.	0.15 (1.14)	0.00 (1.24)	0.45***	1.81
I think pictures from pig barns are appealing.	-0.52 (1.02)	-0.50 (1.10)	0.40***	-0.27
I think pictures from pig barns are repugnant.	-0.20 (1.18)	-0.12 (1.21)	0.49***	-1.04
It gives me a good feeling to see pictures from pig barns.	-0.42 (1.06)	-0.38 (1.17)	0.46***	-0.54

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for paired samples; Pearson correlation coefficients, t-values and p-levels are presented. **= $p \leq 0.01$; ***= $p \leq 0.001$

Source: own calculations

In contrast to split 1, means for all statements regarding the attitude towards pig farming differ significantly before and after having viewed the webcam pictures for split 2, whose members received the neutral texts written by the authors (Table 3). The attitude of respondents towards pig farming is more negative at the end of the survey than at the beginning. Correlations between the means for the evaluation before and after seeing the webcam pictures range between 0.41 and 0.56.

Table 3. Comparison of means between the attitude towards pig farming at the beginning and the end of the survey (after webcam pictures) for split 2 (neutral texts)

Statement	Mean before webcam pictures (SD)	Mean after webcam pictures (SD)	Correlations	t-value
Pigs are not doing fine in modern pig barns.	0.34 (0.97)	0.64 (1.16)	0.46***	-4.23***
Farmers take good care of their pigs.	0.09 (0.85)	-0.29 (1.02)	0.51***	6.31***
Pigs can live according to their natural behavior in modern pig barns.	-0.79 (0.94)	-1.07 (0.97)	0.49***	4.66***
Pigs do not have enough space in modern pig barns.	0.68 (0.99)	1.01 (1.09)	0.41***	-4.69***
I think pictures from pig barns are terrifying.	0.13 (1.15)	0.43 (1.23)	0.56***	-4.24***
I think pictures from pig barns are appealing.	-0.60 (0.94)	-0.86 (1.04)	0.50***	4.08***
I think pictures from pig barns are repugnant.	-0.32 (1.11)	0.23 (1.25)	0.56***	-7.87***
It gives me a good feeling to see pictures from pig barns.	-0.43 (1.07)	-0.77 (1.10)	0.45***	4.77***

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for paired samples; Pearson correlation coefficients, t-values and p-levels are presented. ***= $p \leq 0.001$

Source: own calculations

4.3 Change in attitude towards pig farming dependent on different informational texts

Comparing the attitude towards pig farming between both sample splits before having seen the webcam pictures, no differences can be found at the beginning of the survey ($p > 0.05$; results of independent t-test not presented), disregarding the statement “The pigs are not doing fine in modern pig barns” ($p \leq 0.05$). Respondents in both splits show a rather skeptical view towards pig farming. In contrast, a clear difference in the attitude towards pig farming between both sample splits is evident for all statements at the end of the survey, with the group reading the neutral texts (split 2) evaluating pig farming more negatively (Table 4). The same is true for the comparison between the two sample splits regarding the evaluation of the picture and the text of the pig fattening pen and the farrowing pen: Respondents who were given the neutral texts evaluate both stables more negatively (results of independent t-tests not displayed).

Table 4. Comparison of means between both sample splits regarding the attitude towards pig farming at the end of the survey (after webcam pictures)

Statement	Mean Split 1 Original texts (SD)	Mean Split 2 Neutral texts (SD)	t-value
Pigs are not doing fine in modern pig barns. ¹	0.33 (1.10)	0.64 (1.16)	-3.07**
Farmers take good care of their pigs. ²	0.10 (0.93)	-0.29 (1.02)	4.48***
Pigs can live according to their natural behavior in modern pig barns. ¹	-0.74 (1.03)	-1.07 (0.97)	3.71***
Pigs do not have enough space in modern pig barns. ¹	0.72 (1.13)	1.01 (1.09)	-2.94**
I think pictures from pig barns are terrifying. ¹	0.00 (1.24)	0.43 (1.23)	-3.89***
I think pictures from pig barns are appealing. ¹	-0.50 (1.10)	-0.86 (1.04)	3.70***
I think pictures from pig barns are repugnant. ¹	-0.12 (1.21)	0.23 (1.25)	-3.23**
It gives me a good feeling to see pictures from pig barns. ¹	-0.38 (1.17)	-0.77 (1.10)	3.90***

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for unpaired samples; t-values and p-levels are presented. **= $p \leq 0.01$; ***= $p \leq 0.001$; ¹Variance homogeneity is assumed; ²Variance heterogeneity is assumed;

Source: own calculations

4.4 Comparison between the overall evaluation of webcams as a communication tool in both sample splits

Regarding the evaluation of webcams as a communication tool in general, respondents from splits 1 and 2 do not differ in their opinion; all respondents show a rather low interest in webcams (Table 5). Furthermore, concerning the approval of webcams and the belief that webcams contribute to a better understanding of modern pig farming, members of splits 1 and 2 do not differ in their opinion. Both groups appreciate that farmers show real pictures from their stables, although they are uncertain if webcams and informational texts contribute to a better understanding of pig farming. Only one comparison of means between the two splits reveals a significant difference, regarding the statement: “Webcams do not improve the image of pig farming”. Here, respondents who viewed the webcam pictures accompanied by neutral texts tend to agree more than members of split 1.

Table 5. Evaluation of webcams as a communication tool in both sample splits.

Statement	Mean Split 1 Original texts (SD)	Mean Split 2 Neutral texts (SD)	t-value
I am not further interested in webcams in stables. ¹	-0.23 (1.19)	-0.21 (1.13)	-0.26
Webcams do not improve the image of pig farming. ¹	0.12 (1.19)	0.45 (1.17)	-3.12**
I think it is positive that farmers show real pictures from their stables. ¹	1.05 (0.97)	1.03 (0.86)	0.30
I do not think that webcams and informational texts contribute to a better understanding of pig farming. ¹	-0.04 (1.23)	0.02 (1.21)	-0.51

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for unpaired samples; t-values and p-levels are presented. **= $p \leq 0.01$; ¹Variance heterogeneity is assumed.

Source: own calculations

4.5 Comparison between the evaluation of the pig fattening barn and the farrowing pen

The picture and the corresponding text of the farrowing pen are evaluated more negatively for all statements in both sample splits (Tables 6 and 7).

In split 1, where participants read the original texts written by the farmers, respondents believe that the pigs are not doing fine in the farrowing pen, but are rather doing fine in the pig fattening pen, although farmers are believed to take good care of their pigs in both cases (Table 6). However, people state that the pigs cannot live according to their natural behavior and do not have enough space in both pens, but especially in the farrowing pen. In contrast to the picture of the pig fattening pen, the picture of the farrowing pen has a terrifying and repugnant effect on the respondents. Nevertheless, the picture of the pig fattening pen is also not appealing to participants, nor does it give them a good feeling. Correlations between the means for the evaluation of the pig fattening pen and the farrowing pen are moderate, ranging between 0.27 and 0.47.

Table 6. Comparison of means between the evaluation of the pig fattening pen and the evaluation of the farrowing pen for split 1 (original texts)

Statement	Mean evaluation pig fattening pen (SD)	Mean evaluation farrowing pen (SD)	Correlation	t-value
The pigs are not doing fine in this pig barn.	-0.10 (1.21)	0.36 (1.16)	0.40***	-5.57***
Here, the farmer takes good care of his pigs.	0.35 (1.06)	0.10 (1.08)	0.42***	3.51**
The pigs can live according to their natural behavior in this pig barn.	-0.43 (1.20)	-1.02 (0.99)	0.42***	7.90***
The pigs do not have enough space in this pig barn.	0.38 (1.32)	0.79 (1.18)	0.27***	-4.27***
This picture from this pig barn has terrified me.	-0.37 (1.29)	0.48 (1.35)	0.44***	-9.65***
The picture from this pig barn is appealing to me.	-0.20 (1.25)	-0.87 (1.07)	0.40***	8.29***
The picture from this pig barn is repugnant to me.	-0.40 (1.28)	0.33 (1.35)	0.47***	-8.51***
The picture from this pig barn gives me a good feeling.	-0.25 (1.26)	-0.81 (1.11)	0.39***	6.79***

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for paired samples; Pearson correlation coefficients, t-values and p-levels are presented. **= $p \leq 0.01$; ***= $p \leq 0.001$

Source: own calculations

Respondents of split 2, where the informational texts were written by the authors, also evaluate the farrowing pen more negatively (Table 7). In contrast to split 1, respondents do not think that the farmers take good care of their pigs in either the fattening or the farrowing pen. Pigs are not believed to be doing fine in either of the pig barns, with respect to being able to live according to their natural behavior or to have enough space according to participants. The pictures of both stables are evaluated very negatively and are viewed as being terrifying and repugnant to respondents. Correlations between the means are moderate, ranging between 0.36 and 0.48.

Table 7. Comparison of means between the evaluation of the pig fattening pen and the evaluation of the farrowing pen for split 2 (neutral texts)

Statement	Mean evaluation pig fattening pen (SD)	Mean evaluation farrowing pen (SD)	Correlation	t-value
The pigs are not doing fine in this pig barn.	0.40 (1.20)	0.82 (1.19)	0.44***	-5.30***
Here, the farmer takes good care of his pigs.	-0.16 (1.12)	-0.42 (1.09)	0.48***	3.76***
The pigs can live according to their natural behavior in this pig barn.	-0.89 (1.08)	-1.33 (1.00)	0.36***	5.93***
The pigs do not have enough space in this pig barn.	0.82 (1.21)	1.08 (1.18)	0.39***	-3.12**
This picture from this pig barn has terrified me.	0.12 (1.37)	0.80 (1.32)	0.43***	-7.67***
The picture from this pig barn is appealing to me.	-0.73 (1.20)	-1.28 (1.01)	0.42***	7.27***
The picture from this pig barn is repugnant to me.	0.14 (1.36)	0.77 (1.34)	0.44***	-7.05***
The picture from this pig barn gives me a good feeling.	-0.75 (1.20)	-1.27 (1.00)	0.43***	7.10***

Scale from +2=most positive to 0=neutral to -2=most negative. Means and standard deviations (SD) are displayed in brackets. Comparison of means by t-test for paired samples; Pearson correlation coefficients, t-values and p-levels are presented. **= $p \leq 0.01$; ***= $p \leq 0.001$

Source: own calculations

4.6 Identifying different groups within the whole sample regarding the change in attitude towards pig farming

Seven groups within the whole sample were identified (see Methods section) according to the differences in attitude as measured by a net shift in points per statement on the Likert scale (Table 8). Regarding the whole sample, 8.7% of respondents did not display a different response behavior after having seen the webcam pictures and reading the texts (Group 4). For 22.0% of participants, a very small negative change (1-3 points on the scale; Group 3) can be observed, for 20.7% a small negative change (4-7 points on the scale; Group 2) and for 12.2% a clear negative change (8 and more points on the scale; Group 1). In contrast, 17.3% of the respondents answer slightly more positively after having seen the webcam pictures and reading the texts (1-3 points on the scale; Group 5), 12.2% show a small positive change (4-7 points; Group 6) and 6.9% a clear positive change in attitude (8 points and more, Group 7). In total, 55.1% show a more negative attitude after viewing the pictures and reading the texts, while 36.4% perceive pig farming more positively afterwards. Regarding differences among the groups, it can be stated that the groups do not differ regarding gender, age, income, education or respondents' connection to agriculture ($p > 0.05$). Further, the frequency of having visited a pig barn, the familiarity with webcam pictures and the meat consumption of respondents do not differ between the seven groups ($p > 0.05$). In contrast, the groups differ

significantly regarding the affiliation to the two splits ($p \leq 0.05$), with the percentage of split 2 members (neutral texts) increasing in correspondence with a more negative change in attitude and vice versa. The percentage of members of split 1 (original texts) increases in accordance with a more positive change in attitude (Table 8).

Table 8. Different groups regarding the change in attitude in the whole sample.

Group	1	2	3	4	5	6	7
Definition	Clear negative change	Small negative change	Very small negative change	No change	Very small positive change	Small positive change	Clear positive change
Net change in points on the scale*	8 and more negative	4-7 more negative	1-3 negative	0	1-3 positive	4-7 positive	8 and more positive
Frequencies whole sample [in %]	12.2	20.7	22.0	8.7	17.3	12.2	6.9
Sum whole sample [in %]	55.1			8.7	36.4		
Percentage of members of both splits per group							
Percentage of members in split 1 (original texts) [in %]	33.9	38.1	41.1	50.0	56.8	67.7	88.6
Percentage in members in split 2 (neutral texts) [in %]	66.1	61.9	58.9	50.0	43.2	32.3	11.4

*Net changes of points on the Likert scale were calculated by using the difference between mean indices of all statements regarding the attitude towards pig farming before and after viewing the webcam pictures per participant.

Source: own calculations

4.7 Subjective assessment of attitude change in the different groups

At the end of the survey, respondents were also asked to subjectively estimate the attitude change by indicating if their impression of a modern pig pen was more positive or negative than before viewing the webcam pictures and reading the texts (Statement “Do you think that your impression of a modern pig stable has become more positive or more negative than before?”). 21.7% of respondents from the whole sample think that their impression is more positive than before, while 44.5% do not perceive a change and 33.9% think that their impression is more negative afterwards. For the seven objectively identified groups (Table 8), differences between the groups regarding their responses to the statement are highly significant ($p \leq 0.05$; Table 9). Subjectively estimated attitude change and affiliation to the seven different groups are correlated ($r=0.59^{***}$); this correlation is also evident in the means which are determined to be nearly completely analogous amongst the different groups. Here, the most positive mean indicates a more positive attitude afterwards for Group 7, followed by the means of Groups 6 and 5, respectively. Group 4 shows a negative mean just under 0, indicating a subtle perceived shift towards a more negative attitude afterwards, with Groups 3, 2 and 1 following with higher negative values, respectively, indicating a subjectively estimated deterioration.

Table 9. Mean comparisons using ANOVA and post-hoc tests to define differences between the groups regarding the subjective attitude change indicated (‘Do you think that your impression of a modern pig stable has become more positive or more negative than before?’)

	Groups						
	Mean (SD) Group 1	Mean (SD) Group 2	Mean (SD) Group 3	Mean (SD) Group 4	Mean (SD) Group 5	Mean (SD) Group 6	Mean (SD) Group 7
Change in points on the scale	8 and more negative	4-7 more negative	1-3 and more negative	No change	1-3 more positive	4-7 more negative	8 and more positive
^a Subjective attitude change*** F=47.69	-1.27 ^{all} (0.79)	-0.66 ^{1,3,5,6,7} (0.90)	-0.26 ^{1,2,5,6,7} (0.84)	-0.20 ^{1,6,7} (1.11)	0.18 ^{1,2,3,6,7} (0.78)	0.61 ^{1,2,3,4,5} (0.84)	1.17 ^{1,2,3,4,5} (0.86)

^a Variance heterogeneity is assumed; Tamhane-T2 post-hoc test is used; ^{1,2,3,4,5,6,7} Numbers indicate significant differences between the groups, ^{all} indicates comparisons between all pictures are significant ($p \leq 0.05$); scale from +2= Definitely more positive over 0= neither, nor to -2= Definitely more negative; F = F-value; means and SD (standard deviation), as well as p-levels are presented. ***= $p \leq 0.001$

Source: own calculations

4.8 Differences between the seven groups regarding their attitudes towards pig farming and webcams as a communication tool

The differences between the groups regarding the attitude towards pig farming after viewing the webcam pictures and reading the texts are evident (Table 10) and can be observed when comparing most of the groups. A one-dimensional evaluation factor was used to condense the statements measuring respondents' attitude towards pig farming after viewing the webcam pictures (see Methods section and Table AI in Appendix) to test for differences between the groups: Factor means are graded analogous to the groups, with Group 1 showing the most negative attitude according to the strongest deterioration and Group 7 demonstrating the most positive attitude afterwards according to the strongest improvement in this group.

Fewer differences among the groups are evident with regards to the overall evaluation of webcam pictures and corresponding texts as communication tools (Table 10). Again, in order to condense the statements for the group comparison, two factors (factor 1 'Interest in webcams', factor 2 'Disbelief in image increase through webcams', see Methods section and Table AII in Appendix) were used. Referring to interest in webcams, the two groups showing the strongest improvement in attitude (Groups 6 and 7) indicate the highest degree of interest, followed by the group without a change in attitude (Group 4) and Group 1, the group with the strongest deterioration in attitude. Groups 2 and 3 are rather uninterested in webcam usage in stables. Regarding possible image increase resulting from webcam usage, the groups which deteriorated in their attitude exhibit the largest degree of disbelief in the chance that webcam usage could increase the image of pig farming. In contrast, Groups 6 and 7 rather believe in a positive image increase.

Table 10. Mean comparisons using ANOVA and post-hoc tests to define differences between the groups regarding means for the factors ‘Attitude towards pig farming after viewing webcam pictures’, ‘Interest in webcams’ as well as ‘Disbelief in image increase through webcams’.

Factor	Groups						
	Mean (SD) Group 1	Mean (SD) Group 2	Mean (SD) Group 3	Mean (SD) Group 4	Mean (SD) Group 5	Mean (SD) Group 6	Mean (SD) Group 7
	8 and more negative	4-7 more negative	1-3 more negative	No change	1-3 more positive	4-7 more positive	8 and more positive
Attitude towards pig farming after webcam pictures							
^a Attitude towards pig farming after webcam pictures*** F = 58.16	-0.96 ^{all} (0.61)	-0.57 ^{all} (0.60)	-0.14 ^{1,2,5,6,7} (0.88)	-0.02 ^{1,2,6,7} (1.02)	0.46 ^{1,2,3,7} (0.80)	0.84 ^{1,2,3,4} (0.73)	1.22 ^{1,2,3,4,5} (0.74)
Assessment of webcam pictures and texts as a communication tool							
^b Interest in webcams*** F = 4.35	0.16 (1.11)	-0.26 ⁷ (0.95)	-0.16 ⁷ (1.00)	0.10 (1.01)	0.03 (0.94)	0.15 (0.90)	0.57 ^{2,3} (0.94)
^b Disbelief in image increase through webcams*** F = 7.85	0.11 ⁶ (1.02)	0.34 ⁶ (0.97)	0.13 ⁶ (0.99)	0.09 ⁶ (1.14)	-0.15 (0.86)	-0.61 ^{1,2,3,4} (0.81)	-0.29 (1.00)

^a Variance heterogeneity is assumed; Tamhane-T2 post-hoc test is used; ^b Variance homogeneity is assumed; Scheffé post-hoc test is used; 1,2,3,4,5,6,7 Numbers indicate significant differences between the groups, ^{all} indicates comparisons between all pictures are significant ($p \leq 0.05$); scale from +2= I totally agree over 0=partly, partly to -2= I totally disagree; F = F-value; mean and SD (standard deviation), as well as p-levels are presented; ***= $p \leq 0.001$ All factors based on factor analyses using Varimax rotation; factor ‘Attitude towards pig farming after webcam pictures’ (KMO = 0.90; CA: 0.93); factor ‘Interest in webcams’ (KMO = 0.77; CA: 0.82); factor ‘Disbelief in image increase through webcams’ (KMO = 0.77; CA: 0.54).

Source: own calculations

5 Discussion

5.1 The effect of webcam pictures and informational texts on peoples’ attitudes towards pig farming

Regarding the use of webcams with the aim of enhancing the attitude towards modern pig farming, our results indicate that an improvement can only be achieved for 36.4% of the respondents, with the majority (55.1%) showing a more negative attitude afterwards. Similarly, Möstl and Hamm (2016) found in their qualitative study that the approach of communicating information about pig farming online via blogs, websites or webcams was ultimately ineffective and did not increase acceptance in most cases.

In order to understand why webcam pictures and texts did not improve the attitude towards pig farming for the majority, several facts must be considered: First, the negative effect of webcam pictures and informational texts on the attitude towards pig farming might be due to the fact that the webcam pictures were perceived rather negatively, as observed in the present study. Realistic pictures about intensified animal production are potentially disturbing for people (Kanis et al., 2003; Boogaard et al., 2010; 2011a; 2011b; Zander et al., 2013), as confirmed by other studies (Busch et al., 2015a; 2017; Wildraut et al., 2015), especially when considering that people oftentimes orient their image of modern agriculture to pictures of a rural idyll (Boogaard et al., 2011a).

Our second and third facts to be considered are in line with the conclusions of Möstl and Hamm (2016): Second, regarding the attempt to achieve greater public acceptance through better informing consumers, the deficit hypothesis (Scheufele, 2014) has to be questioned: This hypothesis claims that low acceptance is caused by a limited knowledge of citizens about the reality of production processes (Spiller et al., 2015; Möstl and Hamm, 2016). Nevertheless, this hypothesis is often questioned (Bauer, 2009; Scheufele, 2014) and studies have shown that increased knowledge does not necessarily enhance acceptance, with better informed citizens having been found to be even more critical towards agriculture (Kayser et al., 2012; Zander et al., 2013; Ryan et al., 2015; Spiller et al., 2015). Wildraut et al. (2015) found that providing information about pig farming may alter peoples' evaluation, but existing discomfort may not be dissolved if ethical values are offended.

A third point is related to the assimilation-contrast approach (Anderson, 1973) which suggests that consumers' previously existing attitudes influence how information deviating from these attitudes is perceived (Möstl and Hamm, 2016). The theory indicates that consumer perceptions include zones of acceptance and rejection (Anderson, 1973). If the difference between expectations and e.g., performance of a product is small, suggesting acceptance, then consumers will likely assimilate the difference by evaluating the product relatively in line with their expectations; in contrast, if the difference is large enough to fall into the zone of rejection, a contrast effect can be observed, leading to an even larger perceived discrepancy between the actual product and the expectations (Anderson, 1973). Thus, the theory suggests that it is rather difficult to change previously existing attitudes, especially within a short time (Möstl and Hamm, 2016). Due to the rather skeptical attitude that respondents had towards pig farming at the beginning of the survey, it is more difficult to achieve a positive effect with respect to attitude change.

Assuming that the provision of transparent information fails to improve attitudes among the majority of people, and considering the fact that pictures from stables are typically perceived rather negatively, it is likely that communicating real farm situations might not be sufficient to regain public trust. It is therefore important to continue improving modern husbandry systems and to communicate these advancements, as in the long term only a modification of husbandry systems according to societal requirements will lead to more widespread acceptance (Zander et al., 2013; Ryan et al., 2015; Spiller et al., 2015; Sonntag et al., 2017). Otherwise it is likely that large proportions of the public will continue disapproving of modern pig farming systems (Möstl and Hamm, 2016), even if further endeavors are made to increase transparency.

5.2 The effect of different informational texts

In addition to the fact that webcam pictures may generally not show the desired effects on the public, differences in this study between the two splits, where each received different informational texts, suggest a strong effect of the style of the texts on the attitude towards pig farming. Participants in split 2 who received the neutral texts, showed a clearly more negative attitude towards pig farming afterwards. In contrast, respondents who read the original texts (split 1), which were written by the farmers in a more personal way, were more consistent in their attitude; their evaluation did not differ before and after seeing the webcam pictures, except for responses to one statement.

The negative effect of the neutral texts is also evident among the different groups regarding attitude change among the whole sample (Table 9): Here, the shift towards a more negative attitude is accompanied by a higher percentage of participants who read the neutral texts (split 2). It seems that the rather unemotional and anonymous nature of the neutral texts does not have the power to improve attitudes; on the contrary, these texts deteriorate peoples' attitudes.

In contrast, the stronger the shift towards a more positive attitude, the higher the percentage of split 1 members (who read the original texts) in the respective group. The texts written by the farmers may give readers a better feeling by appearing more trustworthy and more personal. Findings from advertising research indicate that CEOs advertising goods and services of their companies are thought to be more knowledgeable, competent and credible (Stephens and Faranda, 1993). The perception of farmers in this study may be affected similarly. Even though an improvement in the attitude towards pig farming within split 1 cannot be statistically measured (Table 3) with regards to the whole sample, the majority of people who

showed an improvement in attitude after viewing the webcam pictures and texts were those who read the texts written by the farmers, indicating a positive effect of these texts. Nevertheless, most of the people with a more positive attitude afterwards show only minor improvements regarding changes in points on the scale (see Table 8); this might explain why, overall, a significant improvement in attitude cannot be measured for split 1.

Finally, with respect to the effect of webcams in stables, the importance of informational texts can be determined. Neutral informational texts should be avoided in communication efforts – at least for the use of webcam pictures, similar to those investigated here – because they generally deteriorate the attitude of readers. In contrast, more personally or emotionally written texts, as those submitted by the farmers in this study, might at least provide the chance of improving attitudes towards pig farming.

5.3 The effect of different visual content

The clearly more negative evaluation of the farrowing pen in comparison to the pig fattening pen is evident in both splits and confirms findings from other studies, suggesting a lower degree of support for farrowing crates in general (Tonsor et al., 2009; Tonsor and Wolf, 2011; Ryan et al., 2015; Möstl and Hamm, 2016; Sonntag et al., 2017). In line with other studies (Ryan et al., 2015; Sonntag et al., 2017), respondents stated with regards to farrowing crates, that pigs cannot live according to their natural behavior and do not have enough space. Similar to the findings in this study which were also achieved by presenting pictures with informational texts, Sonntag et al. (2017) found that the negative perception of farrowing crates could not be improved even by providing information on the advantages and disadvantages of the system or by explaining the reasons for using it. Moreover, Ryan et al. (2015) showed that providing additional information on the use of gestation stalls led to an even lower degree of support and the majority of participants preferred pregnant sows to be housed in groups. Against the background of these findings and the negative evaluation of the picture of the farrowing pen presented in this study, the question arises as to whether farrowing crates are communicable to the public at all, and whether it is advisable to show pictures of farrowing crates. Webcam usage may still achieve the aim of increasing transparency based on the visibility of production processes (Blokhuis et al., 2003), but public perception of this system is clearly negative. It is likely that farrowing crates, which are generally not accepted by the public, will not achieve public acceptance regardless of how they are presented.

5.4 General evaluation of webcams as a communication tool

Although the utilization of webcams as a communication tool with the intent of increasing public acceptance of pig farming may be seen critically, the findings of the current investigation related to the general evaluation of webcams indicate that respondents generally welcome the concept of farmers showing pictures of their stables. This is in line with the findings of Möstl and Hamm (2016): they found that the effort to increase transparency and to give insight into the husbandry conditions of farm animals was appreciated by respondents. Public desire for transparency also becomes evident when considering the ‘ag-gag’ law situation in the United States, which prohibits the taking of pictures and videos on farms without permission (Shea, 2014; Marceau, 2015; Robbins et al., 2016). Robbins et al. (2016) found that these laws have negative effects on the public, and that restricting transparency damages overall trust in farmers, while harboring the idea that the industry has something to hide (Broad, 2014). Livestock farmers in Germany have also begun to demand federal protection against trespassers on their farms (Topagrar, 2016), as there are currently no laws regarding the prohibition of hidden-camera investigations. Thus, regarding transparency, webcam usage in stables can be a suitable tool for mitigating break-ins and trespassing by animal activist groups, by offensively communicating that farmers do not have anything to hide.

Beyond this positive effect of approving webcams to promote transparency, further success of webcams for the agricultural sector is questionable. With respect to attitude change, different groups in our study were divided on the question of whether webcam pictures and texts actually help to improve the image of pig farming. The groups with a more positive attitude after viewing such materials tend to think that the image could be improved, while the groups with a more negative attitude afterwards tend to decline this idea. Furthermore, respondents are slightly uncertain if webcams and informational texts truly contribute to a better understanding of pig farming.

Additionally, respondents’ comparably low degree of interest in webcams in general is evident. Given the fact that websites providing webcams which record animals in their natural habitats, e.g., in nature reserves in Africa ([ww.africam.com](http://www.africam.com)), draw large numbers of visitors (Kamphof, 2013), the question remains as to why people seem to be less interested in webcam footage from stables, despite the public’s desire to obtain credible, reliable and easily accessible information about the husbandry of farm animals (Vanhonacker et al., 2010). Watching farm animals in their stables is likely to be rather uninteresting in comparison to

watching animals in the wild; furthermore, it should be further considered that peoples' attitude towards livestock farming might be deadlocked (Möstl and Hamm, 2016), preventing them from becoming further involved with agriculture. Moreover, a general interest in agricultural processes and the will to actively search for information cannot be presumed for all consumers (Verbeke, 2005; Vanhonacker and Verbeke, 2014). In the case of food safety, for example, consumers have demonstrated a preference towards remaining imperfectly informed because the price of obtaining information is too high in comparison to the benefits (McCluskey and Swinnen, 2004). Another important aspect could be that people do not want to be reminded of the fact that farm animals are kept for the production of meat, with many consumers having been shown to express feelings of guilt towards farm animals (Te Velde et al., 2002; Vanhonacker and Verbeke, 2014). This issue might prevent consumers from getting more involved with topics related to livestock farming.

Finally, regarding the success of webcams, it seems problematic that the majority of the public (around 90% of participants in both sample splits of the current study) is likely to be unaware of the existence of this communication tool, leading to little attention. If webcams in stables are to be at all effective, they must first be publicized, e.g., through social media via web links, in newspapers or on television, otherwise webcams will fail as a communication tool. However, it is difficult to make suggestions as to how this communication tool and its implementation could be improved, and the general possibility of achieving desired effects seem to be somewhat slim according to the results of this study. Busch et al. (2015b) conclude that low-stimulus pictures of livestock farming, e.g., taken by webcams, can help to make production processes more transparent, but will not gain much attention because there are not enough people interested in viewing such materials. Thus, with respect to the findings of the present study, along with the fact that people would rather not recommend webcam pictures to friends after viewing them (Möstl and Hamm, 2016), the potential success of webcams in general remains questionable.

6 Conclusion

Our study is the first to quantitatively investigate the effects of webcam pictures of pig barns and different informational texts on the attitude towards pig farming amongst the general public. With the help of a randomized between-subject experimental design we reveal that the use of neutrally written informational texts should be avoided. The study provides initial indication that texts written by the farmers in a more personal style might be evaluated more positively by the public. However, the positive effect of such texts is rather low, while the more negative attitude through reading neutrally written texts is striking. Thus, the effects of informational texts should be considered.

Finally, it can be concluded that webcams have two possible levels of impact: The first is on the level of image improvement by providing information via pictures and texts. This level of impact cannot be reached, at least not for the husbandry systems investigated in this study. The second level is related to signaling transparency, which has the potential to increase trust in livestock farming and thereby generate greater acceptance. This level can be rudimentarily approached as the public generally appreciates webcams as a transparency tool; moreover, regarding transparency, showing webcam pictures of pig barns might help to protect farmers from vigilantism by discouraging animal activist groups from breaking into animal farms to investigate husbandry conditions of animals.

Nevertheless, the overall capability of webcams as a communication tool intended to establish a better understanding of modern livestock farming is limited; public interest is generally low and the majority of the broader public is not familiar with webcam usage in stables. Most importantly, it was determined that viewing webcam pictures and informational texts are more likely to diminish, rather than improve the attitude towards modern pig farming. Thus, providing information on critical husbandry systems leads to even lower support, with the majority of participants responding more negatively after viewing the webcam pictures and texts. It can therefore be concluded that the use of webcam pictures as a tool to improve the attitude towards the common pig farming systems, as presented here, cannot be recommended.

7 Limitations

A limitation of this analysis is that conclusions can only be drawn on two specific husbandry systems for pigs, although it is possible that other husbandry systems and their representation through webcam pictures may be more positively perceived, e.g., systems with outdoor access. Another critical remark must be made regarding the comparability of the informational texts in split 1: The texts provided by both farmers were used in their original form and are therefore not entirely comparable, as the personal writing style of the farmers differed. Moreover, the information text for the pig fattening barn contained a picture of the farmer, which may have influenced the evaluation of the pig fattening pen in split 1. Nevertheless, the better evaluation of the pig fattening pen in split 2 further indicates a more negative perception of the farrowing pen in general due to the fact that in this split, both (neutral) informational texts were kept similar. Finally, we want to point out that within this study we were only able to measure temporary attitude changes, and peoples' attitude changes through the use of webcams should be further investigated regarding long-term effects.

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Appendix

Results of both factor analyses (see Methods section) are displayed in Tables AI and AII.

Table AI. Results of factor analysis for condensing statements regarding the attitude towards pig farming after viewing the webcam pictures and informational texts.

Statements	Factor loading	Mean	Standard deviation
Factor “Attitude towards pig farming after webcam pictures” (CA: 0.93)			
Pigs are not doing fine in modern pig barns.	0.82	0.49	1.14
Farmers take good care of their pigs.	-0.81	-0.09	1.00
Pigs can live according to their natural behavior in modern pig barns.	-0.79	-0.91	1.01
Pigs do not have enough space in modern pig barns.	0.75	0.86	1.12
I think pictures from pig barns are terrifying.	0.87	0.22	1.25
I think pictures from pig barns are appealing.	-0.84	-0.68	1.08
I think pictures from pig barns are repugnant.	0.82	0.06	1.24
It gives me a good feeling to see pictures from pig barns.	-0.81	-0.58	1.15

CA=Cronbachs Alpha; factor loadings, means and standard deviations are displayed; N=508; Varimax rotation; Kaiser-Meyer-Olkin-Measure of Sampling Adequacy (KMO)=0.91; total variance explained=65.95% Scale from from +2 ('I totally agree') to -2 ('I totally disagree').

Source: own calculations

Table AII. Results of factor analysis for condensing statements regarding the overall evaluation of webcams.

Statements	Factor loading	Mean	Standard deviation
Factor 1 “Interest in webcams” (CA: 0.82)			
I will further search for webcams used by the agricultural sector in the internet.	0.88	-0.20	1.19
Through the pictures and texts presented I will further deal with the topic of pig farming.	0.87	-0.03	1.11
I am not further interested in webcams in stables.	-0.84	-0.22	1.16
I think it is positive that farmers show real pictures from their stables.	0.58	1.04	0.92
Factor 2 “Disbelief in image increase through webcams”(CA: 0.54)			
Webcams do not improve the image of pig farming.	0.83	0.29	1.19
I do not think that webcams and informational texts contribute to a better understanding of pig farming.	0.80	-0.01	1.22

CA=Cronbachs Alpha; factor loadings are displayed for each factor; means and standard deviations are presented; N=508; Varimax rotation; Kaiser-Meyer-Olkin-Measure of Sampling Adequacy (KMO)=0.77; total variance explained=67.01% Scale from from +2 ('I totally agree') to -2 ('I totally disagree').

Source: own calculations



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Die Wurzeln der **Fakultät für Agrarwissenschaften** reichen in das 19. Jahrhundert zurück. Mit Ausgang des Wintersemesters 1951/52 wurde sie als siebente Fakultät an der Georgia-Augusta-Universität durch Ausgliederung bereits existierender landwirtschaftlicher Disziplinen aus der Mathematisch-Naturwissenschaftlichen Fakultät etabliert.

1969/70 wurde durch Zusammenschluss mehrerer bis dahin selbständiger Institute das **Institut für Agrarökonomie** gegründet. Im Jahr 2006 wurden das Institut für Agrarökonomie und das Institut für RURALE ENTWICKLUNG zum heutigen **Department für Agrarökonomie und RURALE ENTWICKLUNG** zusammengeführt.

Das Department für Agrarökonomie und RURALE ENTWICKLUNG besteht aus insgesamt neun Lehrstühlen zu den folgenden Themenschwerpunkten:

- Agrarpolitik
- Betriebswirtschaftslehre des Agribusiness
- Internationale Agrarökonomie
- Landwirtschaftliche Betriebslehre
- Landwirtschaftliche Marktlehre
- Marketing für Lebensmittel und Agrarprodukte
- Soziologie Ländlicher Räume
- Umwelt- und Ressourcenökonomik
- Welternährung und rurale Entwicklung

In der Lehre ist das Department für Agrarökonomie und RURALE ENTWICKLUNG führend für die Studienrichtung Wirtschafts- und Sozialwissenschaften des Landbaus sowie maßgeblich eingebunden in die Studienrichtungen Agribusiness und Ressourcenmanagement. Das Forschungsspektrum des Departments ist breit gefächert. Schwerpunkte liegen sowohl in der Grundlagenforschung als auch in angewandten Forschungsbereichen. Das Department bildet heute eine schlagkräftige Einheit mit international beachteten Forschungsleistungen.

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