

# The application of a sentiment analysis approach to explore public understandings of animal agriculture

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## ABSTRACT

Ideas about farming are important components of consumers' value judgements about the foods they purchase and consume. Nevertheless, a divide exists between public perceptions and the realities of agricultural practices. We take a novel approach, using sentiment analysis, amongst other methods, to explore what consumers think about farming and how the visual elements of agricultural images might contribute to these perceptions. Data were drawn from responses to questions about three photographs of contemporary UK dairy farms, part of an online survey (n = 521), exploring public perceptions of food and farming. Sentiment and content analysis, descriptive statistics and Spearman's rank correlations were used to analyse the data. Participants thought good animal farming involves an evaluation of both farmers' skill and the relative ethical correctness of certain farming practices. Dirt and untidiness were linked with an increased likelihood of animal disease, and cleanliness and tidiness with a decreased likelihood. According to respondents, keeping cattle inside was problematic, whereas keeping animals outside is more appropriate, linked to their ability to graze in fields and the perceived goodness of a grass-based diet. Respondents discussed the need for farmers to be qualified, passionate and care for their animals. The paper concludes by reflecting on the use of images and sentiment analysis in this type of research, suggesting that along with certain benefits there are limitations to these methods.

## 1. Introduction

In this paper, we take a novel methodological approach, focusing on the use sentiment analysis to explore what consumers think about animal agriculture, and how the construction and presentation of the visual elements of agricultural images might contribute to these perceptions. There is a growing acknowledgement that there needs to be a 'linking-up' of the perspectives of food producers and consumers (Carolan, 2020; Jackson et al., 2022a,b) and a greater understanding of the distinctions and interconnections between these groups (Regan and Kenny, 2022). The public are consumers of agricultural products, and proponents of food democracy argue that all actors in food systems should be actively involved in shaping these systems to ensure that food is produced in a socially acceptable manner (Renting et al., 2012; Hassanein, 2003). Nevertheless, there is a divide between public perceptions of agriculture and the 'realities' of current agricultural practices (Cardoso et al., 2018), and growing anxieties within the agricultural sector around public opinions of animal agriculture, especially within the farming press (see,

Eggleston, 2020; McLaughlin, 2022; Venables, 2022). What consumers think about food, and the production methods used to produce food may be felt by producers, via mechanisms such as purchasing decisions and involvement with organisations related to animals and the environment. We argue that because ideas about farming are important components of consumers' value judgements about the food they consume there is a need to understand what farming means to them. Here we explore these perceptions via the use of images of contemporary UK dairy farms, and sentiment analysis, a relatively novel approach in this type of social scientific research.

This paper begins by discussing the making of consumer identities along with public perceptions of farming and suggest that food may be one of consumers' most important connections with agriculture. We then discuss how public understandings of animal farming in particular are constructed and how farming images shape public understandings of farming and guide consumer conduct. We also explore the concept of agricultural literacy, that is a person's knowledge and understanding of the food and fibre system and their ability to synthesise, analyse, and

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communicate information about agricultural issues. We then describe our methods – the use of photographs of contemporary UK dairy farms as prompts to explore public perceptions of animal farming and the use of sentiment analysis as part of a novel approach to exploring these perceptions. Finally, we reflect on our findings in the context of the existing literature, and on the innovative methods employed in this investigation, before summarising the key implications of the findings.

## 2. Public perceptions of farming

In focusing on public understandings of animal farming, we approach people's perceptions of agriculture largely through their subjectivity as consumers of food. We want to avoid the naturalisation of the identity of 'consumer' and acknowledge that the subjectification of people as consumers will have influenced their responses. 'The consumer' has emerged and changed over time and has been subjectified in particular ways, including in relation to retailers and governments (Trentmann, 2006), and 'mobilised' in relation to specific political, social, and economic conditions (Miller and Rose, 2008). There is differentiation within the general subject category of 'the consumer'. Relatively recently, for example, the identity of the 'ethical' consumer has emerged. This is associated with a sense that people have become increasingly reflexive regarding their consumption practices, are more active as consumers, want to know more about how food is produced, including its social and environmental implications (see e.g., Barnett et al., 2005, 2011; Goodman et al., 2010; Trentmann, 2006; Weatherell et al., 2003).

Food is one of the most important connections the public has with animal agriculture (Boogaard et al., 2011) and consumers are increasingly interested in animal production systems (Clark and Mahon, 2023). Foods can be constructed as 'good', for example, through the use of words such as, 'organic', 'local', or 'sustainable' (Ditlevsen et al., 2019), which position them, often uncritically, in opposition to more 'conventional' items (Eden et al., 2008). Ethical consumers purchase goods based on a range of considerations including environmental and social dimensions of production (Carey et al., 2008; Carrington et al., 2021). Although consumers have been shown to have a mainly positive feeling towards, and a strong sympathy for farmers they are concerned about how the food they consume is produced (Weatherell et al., 2003), especially in relation to animals such as veal calves and, broiler and layer chickens (Mceachern et al., 2005). American citizens' views on pork production systems showed that animal care, access to outdoor spaces, the provision of sufficient space and farm cleanliness – which was associated with animal and subsequently human health, are important considerations (Sato et al., 2017). Benard and de Cock Buning (2013) meanwhile suggest that whereas farmers prioritise the importance of the health and productivity of pigs kept for meat production, the public prioritise the space for animals to move around freely and the ability to perform natural behaviours. In terms of dairy farming, hygiene, animal housing and the ability to graze outside are important dimensions of socially acceptable systems (Boogaard et al., 2011; Jackson et al., 2022a,b).

In relation to cleanliness and hygiene in food and farming systems, research by Ditlevsen and Andersen (2020), which builds on anthropological work on the cultural categories of purity and danger by Douglas (Douglas, 2002; Douglas and Wildavsky, 1983), provides a useful lens to think about these ideas.

Douglas's theoretical model presents a series of contrasting pairs of concepts – purity and impurity, cleanliness and dirtiness, safety and danger, naturalness and transgression, order and disorder (Douglas, 2002). This model is used in research on food choices to explain why people prefer foods perceived as pure, because of the association between purity, cleanliness, order and safety, why and impure, dirty foods are associated with a sense of danger. Ditlevsen and Andersen (2020) update Douglas' definition of naturalness, suggesting that in contemporary Western Europe food choices are still motivated by a desire for

purity and a sense of danger around bodily contamination. However, these choices increasingly stress the importance of naturalness and natural products, even when this incorporates dirty and non-sterile environments, rather than a focus on purity through increased hygiene and sterility. Purity for food and food production thus can now mean the avoidance of the potential or imagined side effects of excessive human interference and industrialised food production (Ditlevsen et al., 2019). See, for example, research by Ryyänen and Toivanen (2022) on media representations of, and the public acceptability of novel technologies in food production, in this case cultured (lab-grown) meat. Here some respondents felt that the production methods used to create cultured meat were so unconventional as to become unnatural. Furthermore, the resultant meat products were thought to be too clean to be healthy, lacking the health-giving microorganisms found on meat from conventionally reared animals.

Despite public concerns and preferences, food production methods are not always a priority when consumers make purchasing decisions (Sato et al., 2017). Consumer action is often constrained by considerations of other product attributes, particularly price, physical access to desired (i.e., ethical) products, and, importantly for this investigation, the availability and use of information (Carrington et al., 2021; Ditlevsen et al., 2019), e.g., via product labelling, advertising, and the media (Barnett et al., 2011). Much of the drive towards ethical food consumption is focused on disseminating information, with the aim of motivating individuals to alter their purchasing and consumption behaviour in favour of socially and environmentally 'better' food (Isenhour, 2012).

Whilst some information about food production is available for consumers, a divide still exists between public perceptions and the realities of modern agricultural practices (Cardoso et al., 2018).

Specht et al. (2014) posit that the disconnect between American school children's perceptions of agriculture and the realities of current agricultural practices can be explained, in part, by the concept of knowledge gaps. Some (Benard and de Cock Buning, 2013; Mceachern et al., 2005) have attributed this knowledge gap to a lack of 'hands on' experience of agriculture (Rumble et al., 2014). Thus, as certain groups of people become more removed from agriculture their perceived need for and the usefulness of, agricultural knowledge decreases and a gap emerges between those with agricultural knowledge and understanding, and those without. Perceptions of farming held by the public are instead influenced by factors including where they live, information provided by media, and cultural representations of farming (Rhoades and Irani, 2008; Boogaard et al., 2011). This can lead to confusion, dissatisfaction, and criticism that agriculture is not living up to expectations when it is encountered, which is problematic if the dominant perception of agriculture is one based on a historical or idealised image (Eden et al., 2008; Rumble et al., 2014). The rural idyll for example, is a normative and power-infused idea of an idealised image of rural and agricultural spaces (Shucksmith, 2018). It reinforces representations of rural spaces as good, problem-free, healthy, peaceful, and unchanging (Little and Austin, 1996). These constructions are often based on nostalgia for an imagined past and an escape from the modernity of urban life (Little and Austin, 1996; Shucksmith, 2018). In a survey of public perceptions from the USA non-rural respondents described the rural United States as "serene, peaceful, and slow-paced" and "old fashioned". Family farms were seen in a positive light, whereas larger scale, corporate farms were perceived more negatively and often as a threat to the smaller family farms (Kellogg Foundation, 2002). Although the construction of rurality takes place over a range of different spatial scales and changes emphasis over time (Little and Austin, 1996), certain elements are durable, and are reproduced and reinforced in images in art, advertising and other media.

The growing concern around this disconnect led, in the United States in the 1980s, to the recognition of the importance of fostering knowledge of food and farming as a way of building public support for agriculture, and development of the concept of agricultural literacy (Reilly

et al., 2022). This is defined as a person's "... knowledge and understanding of the food and fibre system" (Frick et al., 1991: 52). According to this definition an agriculturally literate individual would have some knowledge of food and fibre production, as well as of their "outdoor environment" and be able to make informed choices about their health and diet (National Research Council, 1988). A pivotal work produced by the United States National Research Council put forward the idea that agriculture was "... too important a topic to be taught only to ... students considering careers in agriculture ..." (National Research Council, 1988: 2). Instead, the term encompasses education for all about agriculture and the wider agricultural system. Since then, the concept has been expanded to include the ability to synthesise, analyse, and communicate information about agricultural issues (Trexler and Hess, 2004) and make value-based judgements (Powell et al., 2008), for example the ability to evaluate media related to agriculture (Meischen and Trexler, 2003). There are now calls to broaden it further to include considerations of environmental and sustainability concerns, in recognition of the impact agriculture has on the environment (Reilly et al., 2022).

Agricultural literacy is thought to influence how people perceive agriculture (Hess and Trexler, 2011), and a certain degree of agricultural literacy is necessary for people to be able to make more informed choices about food, and possible future directions for food systems (Hess and Trexler, 2011; Cosby et al., 2022). Specht et al. (2014), for example, noted self-reported levels of agricultural literacy influenced individuals' opinions of news images of agriculture, with those reporting higher levels of agricultural literacy reacting less negatively to the images. Much of the literature on agricultural literacy builds on work on learning developed by cognitive psychologists Jean Piaget (1950) and David Ausubel (1963). They theorised that individuals hold conceptual frameworks – known as schemata, which contain the interconnected information on a certain topic. Learning occurs when new information is encountered and compared to existing schemata. Subsequently, an existing schema can be transformed via construction, deconstruction, and reconstruction, or an entirely new schema can develop (Hess and Trexler, 2011). Thus, learning more about agriculture would transform what a person thinks, that is their existing schema, about food and farming. According to proponents of agricultural literacy there is a need to first gauge an individual's existing knowledge – their pre-existing schema about agriculture – before attempting to impart new information (Meischen and Trexler, 2003; Powell et al., 2008). Understanding how people perceive farming is important to effectively engage them in learning about, discussing and making decisions about the future direction of agriculture and the wider food system (Reilly et al., 2022).

As mentioned above, consumers judge the food they purchase and consume, including the production methods used to produce this food, and ideas about food and farming are constructed and mediated by where consumers live, the information provided by different media and enduring cultural representations of farming (Rhoades and Irani, 2008; Boogaard et al., 2011) in ways that do not always represent the realities of contemporary farming. At the same time farmers are increasingly anxious about public perceptions of the industry (Boogaard et al., 2011b; Drummond et al., 2000), especially around certain dimensions of animal agriculture. There is growing evidence for this in the farming press (see, Eggleston, 2020; McLaughlin, 2022; Venables, 2022), and concerns exist around the growing popularity of vegetarian, vegan and flexitarian diets, public perceptions of farm animal welfare, as well as the links between animal agriculture and zoonoses, and the implications this may have for the future of the industry. Nevertheless, public acceptance and understanding of farming systems is crucial for the ongoing sustainability and social licence to operate (the public continuing acceptance of the industry's practices) of the industry (Jackson et al., 2022a,b; Kühl et al., 2019). In this paper, we contribute to the existing literature by exploring what members of the public think about agriculture and what visual elements contribute to these constructions, via the use of images of contemporary animal agriculture and analytical approach that involves the use of sentiment analysis.

### 3. Images as research methods

The role and value of images in influencing consumer behaviour is well known. Childers and Houston (Childers and Houston, 1984: 643) described the "picture superiority effect" on consumer memories, with images easier to memorise, recall and recognise than text. Memories of images also last longer than those of words and an image can convey information about an object far more succinctly than text. Images can act as "evocations" – working as both carriers of cultural meaning and containing a powerful descriptive charge (Rose, 2008). At the same time, an image can confront the viewer with something strange or surprising to elicit a response. We build on a growing body of work that uses images to explore public perceptions of rural and agricultural spaces (Rumble et al., 2014), including dimensions of animal agriculture (Busch and Spiller, 2018). This work has used images to explore the role of housing, transport and sex-selective culling on public perceptions of animal welfare and care (Kühl et al., 2019; Napolitano et al., 2007). Studies have used a range of types of images, including single and composite photographs (Reithmayer et al., 2021), photo-shopped images, video clips (Gauly et al., 2017; Wernsmann et al., 2018), and elicitation activities in which participants are asked to draw farms themselves (Wellbrock et al., 2019), or react to artists' sketches of farms (Jackson et al., 2022a,b). Sontag (1978) has suggested that photographs are perceived as different to text and paintings, in that the latter are seen as interpretation, whereas the former is seen as more "transparent". However, photographs are still constructed images; the photographer imposes their own standards and worldviews on how a photograph is composed/constructed and which photograph, of potentially multiple shots, is chosen (Berger, 1972). Furthermore, images are not neutral; the season, weather, location and angle of a photograph will all alter how its subject is perceived. The use of digital cameras has transformed photography, allowing images to be more easily manipulated via camera setting and computer software. Busch et al. (2017) describe how photographs of farmed animals taken at different angles (i.e., from the perspective of a human, an animal, or a "bird's eye view"), and with animals in various positions, were evaluated differently by members of the public. Space allowance was rated more positively if the image was taken at a "bird's eye view", and animals lying down were associated with illness. In addition, Wildraut et al. (2015) found that the lighting levels in video clips of pig farming influenced public perceptions of the farms depicted.

Whilst recognising that photographic images are constructed and value-laden, they remain valuable tools in research exploring public understandings and opinions on food and farming because of their memorability and power to convey large amounts of information succinctly. Farming needs to be both visible and accessible in some way to the evaluator to be judged. In this research, we provided the participants with a series of photographs of animal farming, rendering these farms visible. In terms of accessibility, members of the public may not always have physical access to agricultural spaces. Much of the farmland in the UK is not open to the public, having no footpaths, public rights of way or open access land. This includes, in the UK, open access land within 20 m of a building containing livestock, which is excluded from public access (Natural England, 2019). In addition, many farming practices happen inside farm buildings. Issues of accessibility are mitigated here by providing participants with photographs, images of 'real world' farms that they might not ordinarily have access to.

Data were responses to questions included as part of an online survey exploring public perceptions of food and farming. The survey was conducted as part of a wider research project exploring the sustainable reduction of endemic livestock disease in northern England (<https://field-wt.co.uk/>). The focus of the project therefore influenced the questions that were asked in the online survey. The photographs used in the survey (Fig. 1) were taken by the authors on dairy farms in the north of England between 2019 and 2020. Permission was given by the farmers prior to taking the photographs and the images were taken in



Photo A



Photo B



Photo C

Fig. 1. The three images of dairy farms used to explore participants' perceptions of farms and farming.

situations and at angles to ensure that no people or identifying features were photographed. Further permission was sought to use the images in the survey. The three images were chosen to show some of the variation in UK dairy production systems. As people's ideas about animal agriculture may vary according to the particular farming sector (Boogaard et al., 2011b) only images of dairy farming were used, to provide consistency.

Participants viewed each image and the questions related to it on a single 'page' of the survey, either sequentially, or moving between them as they wished. The following information was provided: "All the farms in the photographs are UK dairy farms, which raise cows that produce milk". Each image was used to elicit responses to an open-ended question and three Likert scale questions. The open-ended question asked participants to describe their impression of each image. Five-point Likert scale questions asked respondents to indicate their views on.

- a) How 'natural' the scene represented in the image is,
  1. Very unnatural, 2. Unnatural, 3. Neither unnatural nor natural, 4. Natural, 5. Very natural.
- b) The 'welfare' of the cows,

- 1. Very poor welfare, 2. Poor welfare, 3. Neither poor welfare nor good welfare, 4. Good welfare, 5. Very good welfare.
- c) The likelihood of those animals becoming diseased.
  1. Very unlikely, 2. Unlikely, 3. Neither unlikely nor likely, 4. Likely, 5. Very likely.

An open-ended question asked participants to describe what a good farm would look like. Two further questions explored respondents' connections with farming and gave some indication of how they might learn about it from 'real life' experiences. The first asked whether the respondent has or had any connection to farming, and if so what type of connection (e.g., they might work in the agricultural sector, or have friends or family who do), and the second asked whether they had visited a farm in the past five years, and if so what was the purpose of the visit (e.g., using a farm shop, or as part of an educational or recreational activity, etc.).

Ethical approval was obtained from Newcastle University (Reference 3434/2020), and informed consent was obtained from participants prior to completing the survey. The survey was piloted with 12 members of the public in June 2020 and subsequently run from 5th October to November 1, 2020.

The survey was designed in Qualtrics survey software (Qualtrics, 2020) and was shared with participants online. A representative sample (n = 520) of the UK population was obtained via the Qualtrics consumer panel, with respondents matched for age and gender based on UK census data (Table 1). Both consumers and non-consumers of animal products were included. All responses were quality checked independently by two of the authors, based on 1) minimum time to complete, 2) duplicate responses given multiple times in a row for Likert scale questions and, 3) unintelligible answers for the open-ended questions. The findings of the two quality checks were compared and responses that failed the check were removed. Additional participants were recruited to make up the sample size.

Responses to the question asking participants to describe their impression of each image varied in length from a single word or phrase to multiple sentences, although the majority were short in length. Due to the large number and the short length of the responses traditional qualitative analysis alone was not considered appropriate. Therefore, a mixed methods approach, which applied sentiment analysis as well as descriptive statistics and content analysis, was undertaken. This approach is advocated by Steede et al. (2018), who suggest that sentiment analysis alone cannot fully explore the nuance of text and should be supported by other forms of analysis.

Sentiment analysis was conducted using Natural Language Processing (NLP). NLP is a computational approach to the analysis of human language, referred to as ‘natural language’ to distinguish these from artificially constructed languages such as computer programming languages or Esperanto (Crowston et al., 2012; Tierney, 2012). The goal of NLP is to understand the meaning of a piece of language and analyse some aspect of this meaning. Sentiment analysis is a type of NLP used to measure whether the opinions expressed towards a particular entity are favourable (positive) or unfavourable (negative) (Nasukawa and Yi, 2003; Liu, 2012). As an analytical tool, sentiment analysis is an emerging analytical tool, increasingly used to investigate views expressed on social media platforms (e.g., Oscar et al., 2017; Trovato et al., 2020). Furthermore, it has been proposed as a powerful tool for use in the agricultural sphere (Bermeo-Almeida et al., 2019). For example, Chae et al. (2018) proposed sentiment analysis as a tool to explore Korean citizens’ emotional responses to a Foot and Mouth disease outbreak, and Mahoney et al. (2020) investigated public

perceptions of agricultural fairs on social media as a tool to gauge the use of these events as venues for public engagement and education. Although Mahoney et al. (2020) note the positive sentiment expressed by the majority of social media users, public concerns about biosecurity and zoonotic disease risks were evident. This illustrates the usefulness of sentiment analysis at identifying specific areas of concern or criticism from large volumes of data. Steede et al. (2018), meanwhile, used sentiment analysis to investigate the way in which certain individuals and special interest groups with particular agendas act as ‘influencers’ on social media, shaping public perceptions of the use of antibiotics in the farming industry in the USA. Dicks et al. (2021) mined social media posts in part to assess public sentiment around UK government policy aimed at managing bovine Tuberculosis. They note the potential of sentiment analysis in surveying public perceptions of agricultural policy, and its usefulness as a tool to identify and begin to address areas of miscommunication and misinformation between the agricultural industry and the general public. Here we further test the application of sentiment analysis to the UK farming context.

In this investigation sentiment analysis was conducted via the package ‘sentimentr’ (Rinker, 2019) using R (R Core Team, 2021). This is a lexicon-based package used to calculate the polarity of text, while taking into account words that act as valence shifters (e.g., words that negate, amplify, or de-amplify a statement). Sentimentr calculates the polarity of statements as numeric sentiment scores.

For the analysis in sentimentr –

Sentiment scores above zero = a positive sentiment.

A sentiment score of zero = a neutral sentiment.

Sentiment scores below zero = a negative sentiment.

The incorporation of valence shifters in the package is a benefit when compared to other R packages which focus more on the overall polarity of text, rather than adjacent words which may modify the polarity of individual phrases. This provides a more nuanced NLP technique as words are analysed in context rather than individually.

Further analysis of the participants’ impressions of each image was conducted via content analysis of the most frequently used words (Cavanagh, 1997; Hsieh and Shannon, 2005). Word frequency searches were conducted using Nvivo software (QSR International Pty Ltd, 2020) using the following search criteria:

1. The search was limited to the top 100 most frequently used words.
2. Only words of four letters or longer were included (thus removing less relevant but frequently used words such as, ‘and’, ‘I’, and ‘of’).
3. Stemmed words were consolidated (for example, ‘content’, ‘contented’, and ‘contentedly’ were grouped together as the stemmed word ‘content’).

Words of four letters or longer, but of less relevance to the analysis (e.g., “looks”, “much”, “impression”, etc.) were removed. Following this, words mentioned ten times or more by the sample of respondents were tabulated (photograph A n = 17, photograph B n = 22, photograph C n = 15) and grouped into ‘themes’. The proportion of words within each theme was calculated as percentages to facilitate comparison. These themes were also used to explore the responses to another question exploring the respondents’ perceptions the visual elements of the images, ‘What would a good farm look like?’

The responses to the Likert scale questions were inputted into SPSS (IBM Corp. Released, 2020) and descriptive statistics were calculated. Spearman’s rank correlation was used to determine the relationship between the three Likert Scale questions. All correlations were run at the 5% significance level, and defined as weak (0.1–0.3), medium (0.4–0.6) and strong (0.7–0.9) correlations (Dancey and Reidy, 2007). Content analysis and analysis of the Likert scale questions via descriptive statistics were conducted as a form of methodological triangulation, and a way to provide further details as to the reasons why respondents were expressing certain degrees of sentiment that sentiment analysis alone could not provide.

**Table 1**  
Respondent characteristics.

Participant Characteristics	Number of respondents (%)
<b>Age</b>	
18–24 years	61 (11.7)
25–34 years	102 (19.6)
35–44 years	94 (18.0)
45–54 years	103 (19.8)
55–64 years	87 (16.7)
65+ years	74 (14.2)
<b>Gender</b>	
Men	251 (48.2)
Women	267 (51.2)
Genderqueer or non-binary	3 (0.6)
<b>Region</b>	
England	443 (85.0)
Scotland	36 (6.9)
Wales	25 (4.8)
Northern Ireland	17 (3.3)
<b>Location</b>	
City centre	110 (21.1)
Town or suburb	301 (57.8)
Rural area	110 (21.1)
<b>Dietary choices</b>	
I eat meat and plants	397 (76.2)
I am a flexitarian	72 (13.8)
I am a vegetarian	33 (6.3)
I am a vegan	11 (2.1)
I do not wish to specify	8 (1.5)

#### 4. Farming images: sentiment and content analysis

Scatter plots of the sentiment scores were produced for each of the three photographs (Figs. 2–4). The x-axis relates to the participant ID code, and the y-axis to the polarity of the sentiment scores. The plots provide a sense of the polarity of the sentiments expressed by participants towards each of the images.

The sentiment scores for photograph A showed that respondents had mixed feelings about this image. Approximately thirty percent of responses were scored as above zero (30.8%), indicating that the statements contained positive sentiments, and a similar proportion were scored as neutral (31.5%). A slightly higher proportion were scored as below zero (37.7%), indicating that the sentiments contained negative sentiments.

The sentiment scores for photograph B indicated that the participants expressed greater positive feelings towards this image (78.1% of responses were scored as above zero). A small proportion of participants expressed negative sentiment (2.3% of responses), and approximately one fifth of responses expressed a neutral sentiment towards this image (19.6% of responses were scored as neutral).

The sentiment scores for photograph C indicated that almost two thirds of the responses expressed a negative sentiment about this image (60.0% of responses were scored as below zero). Approximately one quarter of responses were scored as expressing a neutral sentiment (26.7% of responses) and 13.3% of responses were scored as expressing a positive sentiment.

Content analysis of the responses added more depth to the understanding of what the participants were responding to in describing their impressions of each image. The results of the word frequency search were organised into five themes informed by the literature on public perceptions of animal agriculture (e.g., Boogaard et al., 2010, 2011; Busch et al., 2017; Jackson et al., 2022a,b, Rumble et al., 2014). These thematic groupings included words describing or associated with:

1. The **health and welfare** of the animals in the photographs, e.g., “healthy”, “happy”, and “fresh”.
2. The **physical conditions** in the photographs, e.g., “shed”, “indoors”, and “outside”.
3. The **cleanliness and/or dirtiness** of the environment, e.g., “clean”, “dirty”, and “messy”.
4. **Food, feeding and abundance**, e.g., “grazing”, “food”, and “plenty”.
5. **Moral and ethical judgements**, e.g., “good”, “great”, and “poor”.

A sixth category was created for ‘Other’ words that could not be placed within the five themes mentioned above, e.g., “organic”, “environment”, and “access”.

For Photograph A (Table 2) words relating to all five themes (plus the sixth category “other words”) were identified. Those associated with physical conditions were most frequently mentioned, with participants using words such as “crowded”, “caged”, and “cramped”, suggesting that respondents’ perceptions of the physical conditions were contributing to the negative sentiment expressed in responses to this image. Nevertheless, the words relating to the other themes, although mentioned fewer times, were described using more positive words. For example, the theme cleanliness/dirtiness is described with words such as “organised” and “tidy”.

For photograph B (Table 3) words linked to four themes (plus the sixth category “other words”) were identified – words related to ‘Cleanliness/dirtiness’ were not identified in the sample. Words associated with “Health & welfare” were mentioned most frequently and this dimension was perceived in a positive light. Likewise, the other themes were described using positive words.

For Photograph C (Table 4) words related to four themes (plus the sixth category “other words”) were identified – the theme ‘Health & welfare’ was not identified in the sample. The words used to describe the theme ‘Physical conditions’ were similar to those used to describe photograph A (e.g., “crowded” and “cramped”), with the addition of words to describe the fact that the animals in the photographs had access to outside space. However, in contrast to Photograph A ‘Cleanliness/dirtiness’ was described negatively.

Three further questions focused on animal welfare, perceived diseased status of the animals, and naturalness. The results for each photograph are tabulated below (Tables 5–7).

The cattle in photograph A were considered to have better welfare, and less likely to be diseased than those in photograph C, but to have poorer welfare and more likely to become diseased when compared to those in photograph B. However, the animals in photograph A were thought to be in the least natural environment of the three images. Photograph B is consistently rated better than photographs A and C across all three criteria. The cattle in photograph B were considered to have better welfare, a more natural environment and were less likely to be diseased than the animals in photographs A and C. The cattle in photograph C were thought to have poorer welfare and were more likely to be diseased than photographs A and B. The environment in photograph C was thought to be less natural than photograph B and slightly more natural than photograph A.

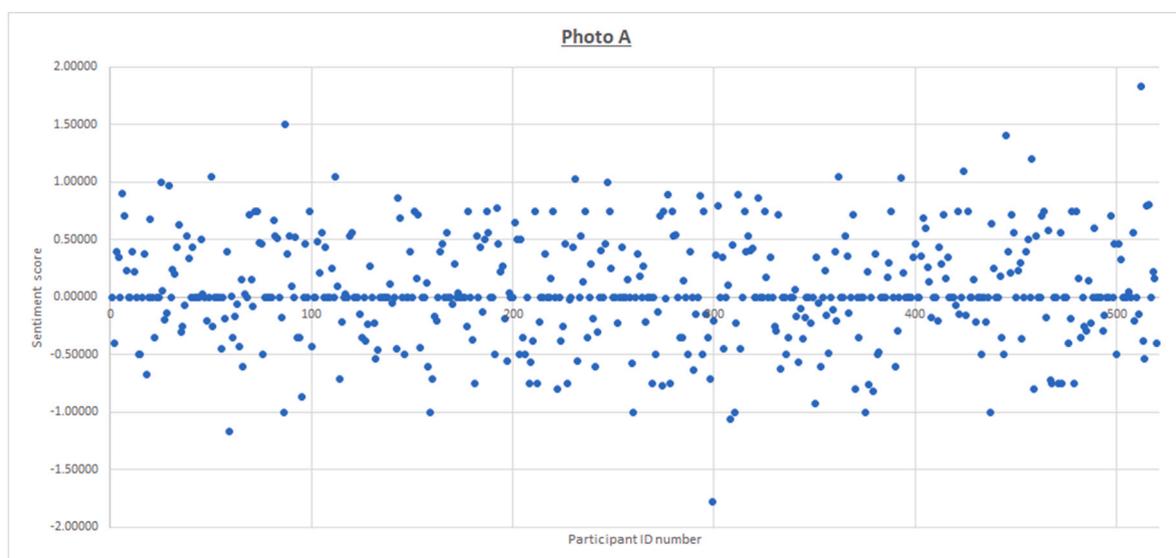


Fig. 2. Sentiment scores for Photograph A.

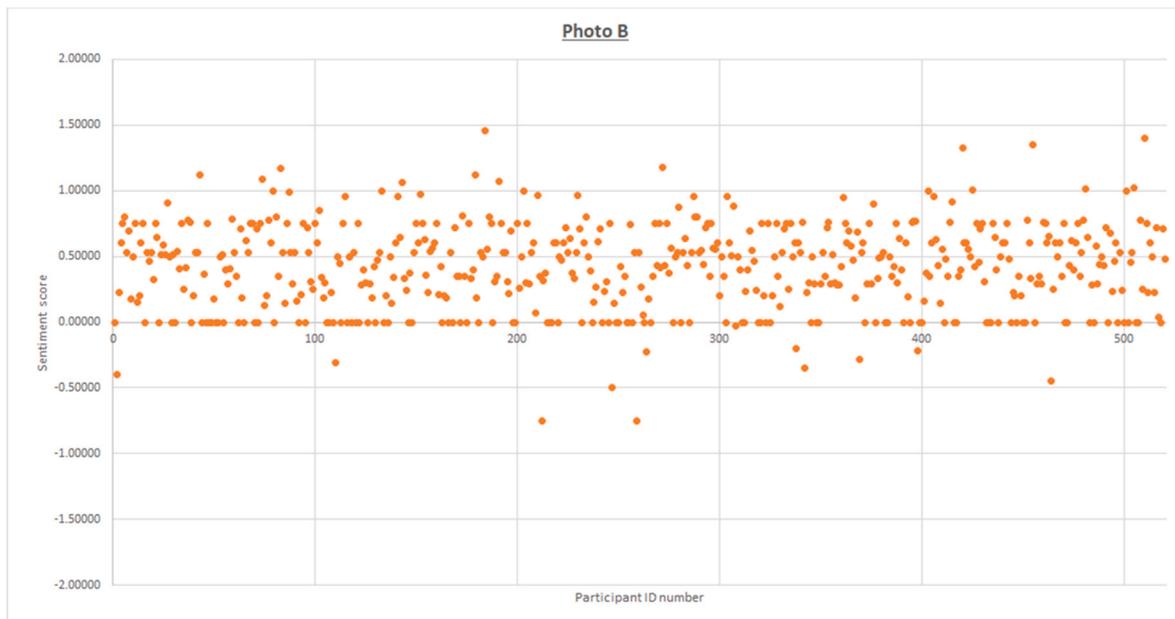


Fig. 3. Sentiment scores for Photograph B.

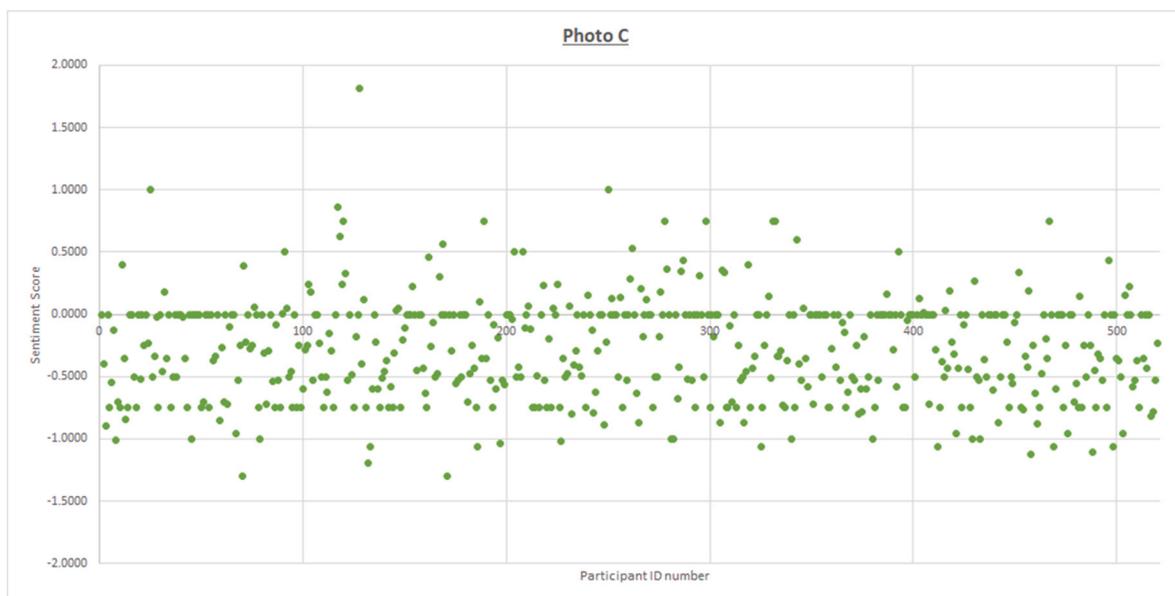


Fig. 4. Sentiment scores for Photograph C.

Table 2  
Photograph A

Theme name	Proportion of words within each theme	Words used
Physical conditions	47.05%	Crowded, cramped, space, indoors, caged, outside, conditions, shed
Cleanliness/dirtiness	17.65%	Clean, organised, tidy
Food, feeding & abundance	11.76%	Food, plenty
'Other' words	11.76%	Access, environment
Moral/ethical judgements	5.88%	Good
Health & welfare	5.88%	Healthy

Table 3  
Photograph B.

Theme name	Proportion of words within each theme	Words used
Health & welfare	31.81%	Natural, free, happy, healthy, fresh, freedom, content
Physical conditions	22.72%	Field, roam, space, outside, outdoors
Food, feeding & abundance	18.18%	Grazing, grass, lots, plenty
Moral/ethical judgements	18.18%	Good, better, nice, great
'Other' words	9.09%	Environment, organic
Cleanliness/dirtiness	0.00%	

**Table 4**  
Photograph C.

Theme name	Proportion of words within each theme	Words used
Physical conditions	40.00%	Crowded, cramped, yard, space, area, outside
Cleanliness/dirtiness	33.33%	Dirty, muddy, messy, filthy, mucky
Moral/ethical judgements	13.33%	Good, poor
Food, feeding & abundance	6.66%	Grass
Other words	6.66%	Environment
Health & welfare	0.00%	

**Table 5**  
How would the respondents rate the welfare of the cattle in photographs A, B, and C.

	Photograph A		Photograph B		Photograph C	
	Count	Percentage	Count	Percentage	Count	Percentage
Very poor welfare	44	8.40%	5	1.00%	89	17.10%
Poor welfare	129	24.80%	9	1.70%	165	31.70%
Neither poor nor good	161	30.90%	35	6.70%	171	32.80%
Good welfare	156	29.90%	212	40.70%	81	15.50%
Very good welfare	31	6.00%	260	49.90%	15	2.90%

Results of the Spearman’s rank correlation (Table 8) show a moderate to strong positive correlation between the perceived naturalness of the environment the cattle are kept in, and their perceived welfare, indicating that the more natural a farm environment is perceived to be the higher the animals’ welfare is perceived too. For the other two relationships tested, weak relationships were found, apart from for Photograph C. For this image there was also a moderate negative association between the perceived naturalness of the environment and the perceived likelihood of disease, and the perceived welfare of the cattle and the perceived likelihood of disease. In other words, the less natural the environment and the lower the perceived welfare, the higher the

**Table 6**  
How natural would the respondents consider the environment cattle in photographs A, B, and C are in.

	Photograph A		Photograph B		Photograph C	
	Count	Percentage	Count	Percentage	Count	Percentage
Very unnatural	103	19.80%	8	1.50%	101	19.40%
Unnatural	176	33.80%	11	2.10%	161	30.90%
Neither un-natural nor natural	129	24.80%	42	8.10%	168	32.20%
Natural	83	15.90%	156	29.90%	72	13.80%
Very natural	30	5.80%	304	58.30%	19	3.60%

**Table:7**  
How likely the respondents think it is that the cattle in photographs A, B, and C will become diseased.

	Photograph A		Photograph B		Photograph C	
	Count	Percentage	Count	Percentage	Count	Percentage
Very unlikely	21	4.00%	91	17.50%	17	3.00%
Unlikely	102	19.60%	172	33.00%	42	8.10%
Neither likely nor unlikely	193	37.00%	166	31.90%	183	35.00%
Likely	163	31.30%	58	11.10%	178	34.20%
Very likely	42	8.10%	34	6.50%	101	19.40%

perceived likelihood of disease.

An open-ended question asked participants to describe what a good farm would look like. The responses were analysed in the same way as the qualitative responses to the three photographs and organised using the same five thematic groupings as above (excluding the ‘other’ category).

Responses indicated that participants were considering multiple dimensions of agriculture when describing a good farm (Table 9) and a range of agricultural systems, not just animal agriculture (e.g., “crops” and “plants” which could relate to arable, horticultural, or mixed farming systems). The people involved in farming were also discussed. There were mentions of the qualities of a good farmer, i.e., “friendly”, “passionate”, “strict”, “qualified”, and roles people could have on a farm, e.g., “farmer” and “worker”.

Both the farmed and unfarmed environment were mentioned, for example, one response mentioned the following,

“It would have lots of natural areas such as hedgerows, and there would be lots of wildlife around”

This suggests an interest in concerns beyond agricultural production and an awareness of, or desire for, multifunctional and biodiverse agricultural spaces.

In terms of the qualities, attributes and outcomes of a good farm, words related to tidiness were mentioned frequently, e.g., “tidy”, “neat”, “orderly” and “organised”, as well as those related to cleanliness,

**Table 8**  
Results of the Spearman’s rank correlation between perceived welfare of the cattle, naturalness of the environment and likelihood of disease across Photographs A, B and C.

Relationship tested	Photograph A	Photograph B	Photograph C
Perceived naturalness of environment vs. Perceived likelihood of disease:	$R_s (519) = -0.253, p=0.000$	$R_s (519) = -0.296, p=0.000$	$R_s (519) = -0.402, p=0.000$
Perceived naturalness of environment vs perceived cattle welfare	$R_s (519) = 0.647, p=0.000$	$R_s (519) = 0.590, p=0.000$	$R_s (519) = 0.755, p=0.000$
Perceived cattle welfare vs perceived likelihood of disease:	$R_s (519) = -0.337, p=0.000$	$R_s (519) = -0.287, p=0.000$	$R_s (519) = -0.441, p=0.000$

All correlations were run at the 5% significance level and defined as weak (0.1–0.3), medium (0.4–0.6) and strong (0.7–0.9) correlations (Dancy and Reidy, 2020).

**Table 9**  
Themes and associated words used to describe a ‘good farm’.

Theme name	Examples of words used
Physical conditions	Equipment, machinery, housing, spacious, roam, fields, hedgerows
Cleanliness/dirtiness	Clean, tidy, neat, orderly, organised, maintained, managed
Moral/ethical judgements	Good, great, nice, friendly
Food, feeding & abundance	Grazing, pasture, grass, feed, plenty, lots
Health & welfare	Healthy, welfare, cared, content, happy, safe, free, natural

suggesting the importance of appearance in determining whether a farm is good. For example, the following responses stated that a good farm would be:

“Neat and tidy, looked after, then there is a good chance the animals will be the same”

“Clean apparatus and equipment and healthy animals”

“Well ordered and the machines looked after”

The first quotation illustrates the way that some participants linked tidiness with cleanliness, and in turn linked these two ideas with animal health and welfare. This indicates that to these participants clean, tidy spaces are less likely to have unhealthy animals, or animals with poor welfare. The subsequent two quotations widened this desire for cleanliness and tidiness shown by respondents out to include consideration of the infrastructure and machinery used on farms.

The importance of animals being outside or having access to the outside was frequently mentioned. One participant mentioned the following:

“Lots of empty space for animals to roam, actually giving the animals proper food for their species”

This desire for animals to be outside was often linked to the perceived appropriateness of animals’ diets and to space allowance, with the suggestion that animals outside are likely to have more space than those inside.

Nevertheless, some participants found answering the questions difficult, as illustrated by the following quotation,

“I wouldn’t know these days. So many new innovations that have happened over the past decade.”

This suggests a recognition that the mental images of farming held by the participants might not accurately reflect the realities of modern agriculture.

Finally, two questions explored respondents’ connections to farming. Almost three quarters (72.7%) of respondents stated that they had no connections to farming, and almost half (48.4%) had not visited a farm in the past five years. Of the respondents who had visited a farm in the past five years, the most common types of visits were, visiting a farm shop (22.6% of respondents), walking across a farm (19.6% of respondents), and visiting a farm as part of an educational activity (12.3% of respondents). Only 3.1% of respondents worked in agriculture.

## 5. Unpacking the perceptions and realities of animal farming

The findings of this study build on previous work exploring, via visual tools, what people think about how food is produced, and which visual elements contribute to these constructions. Understanding how people perceive farming is important to effectively engage them in learning about and discussing agriculture and the wider food system. In this penultimate section, we first discuss the empirical findings before critically reflecting on the methodological approach taken.

### 5.1. Empirical findings

Although all of the participants were able to make sense of the images presented in the survey, how they interpreted each image may relate to the different ethical positions they hold, the different criteria they used to evaluate the images, and their degree of agricultural literacy (Frick et al., 1991), that is the schemata they have developed about agriculture, and in particular about the dairy industry. Most participants were able to meaningfully evaluate certain elements in the images provided, suggesting that they had enough knowledge and understanding of what most of the images represented to answer the questions. Although earlier definitions of agricultural literacy focused on levels of knowledge alone (e.g., Frick et al., 1991), contemporary definitions have emphasised the ability to evaluate information about agriculture and make ethical judgements (e.g., Clemons et al., 2018; Reilly et al., 2022). Indeed, much of the evaluation of the three images provided by the participants related to ethical judgements, i.e., how right or wrong certain practices related to animal agriculture were perceived to be, rather than evaluations of the skill of farmers in performing agricultural practices. Examples included comments related to animals being kept outdoors, which was perceived to be more ‘right’ than animals keeping animals indoors. This is in line with previous findings (e.g., Benard and de Cock Buning, 2013; Boogaard et al., 2011; Sato et al., 2017) which have also indicated the public’s preference for animals kept outdoors. Nevertheless, participants were also able to judge some of the outcomes of agricultural practices they saw in the images as performed in either a skilled or a less skilled fashion. This was particularly apparent in participants’ perceptions of the tidiness or untidiness of the farmed spaces, which was related to cleanliness, and to perceived animal health and welfare.

The three photographs did not contain any images of people due to the need to maintain the anonymity of the farmers and farms visited. Respondents therefore could not make any specific comments about the people working on these farms. They did however discuss the preferred qualities of a farmer, albeit in relation to agriculture in general, rather than animal agriculture specifically. The need for a farmer to be friendly was mentioned. The literature on good farming emphasises that the role of the good farmer goes beyond farming into considerations of the farmer’s interaction with their wider community (Burton et al., 2021), for example, as a neighbour and as a member of the local community (Enticott et al., 2021; Westerink et al., 2021). Respondents also noted the need for farmers to be qualified and passionate about their job. The requirement for farmers to be qualified suggests the importance to respondents of institutionalised cultural capital in the form of qualifications obtained via formal education or training, and/or embodied cultural capital in the form of acquiring skill in performing practices to public understandings of good farming (Burton et al., 2008).

That a good farm would have animals which were well cared for was mentioned frequently. Caring for animals’ health and welfare has been mentioned as an important dimension of good farming from the farmer perspective too (Burton, 2004; Butler and Holloway, 2015; Shortall et al., 2017). Nevertheless, some dimensions of good animal farming defined as important in the literature from farmers’ perspectives were not discussed. The ability of farmers and stock people to detect ill-health or injury (Buller and Roe, 2018; Defra, 2004) was not mentioned in great depth by respondents beyond stating that the animals should be safe and healthy. Also not discussed were considerations of the other side of the relationship, i.e., the agency and qualities of the animals that may influence the practice of stockkeeping (Hemsworth, 2003; Wildraut et al., 2015). This suggests limits to the agricultural literacy of the respondents regarding knowledge about the practices performed by farmers and stock people.

A lack of sufficient agricultural literacy was illustrated by some participants who recognised that they did not have enough knowledge about farming to be able to evaluate some of the practices they identified in the images. This was especially related to, as one participant

described it, "... new innovations ..." These participants felt they could not judge modern agricultural practices related to keeping animals because they did not know enough about them. These findings thus suggest a continuing disconnect between what the public know about animal farming and the realities of contemporary animal agriculture and perhaps also the continued prominence of the rural idyll – an image of farming as unchanging and traditional, in people's perceptions of agricultural spaces. This has implications for those farmers who use novel technologies on their farms which may not be understood and thus be perceived negatively by members of the public, but which are intended to improve the health and welfare of farm animals, e.g., the increasing use of automation on farms, or the use of synthetic livestock vaccines (Ditlevsen et al., 2020). It also indicates an important gap for agricultural educators to begin to explore with the wider public.

The results of the questions exploring respondents' connections to agriculture indicate that most respondents are not obtaining knowledge about farming from a direct connection to agriculture, and a large proportion don't have regular or recent contact with farming. But there are other ways to learn and experience agriculture that are open to them and some of the respondents in this investigation use these, e.g., participating in direct sales from farms, and via recreation and tourism in agricultural areas. A smaller percentage also indicated that they learn about agriculture through traditional educational routes. These findings highlight an opportunity to engage the public in conversations about food and farming both in more formal settings, such as school, and increasingly in less formal settings, such as farmers using social media, or farm shops and farm open days to inform and engage with the public. Previous work has indicated that there is a public appetite for these types of informal opportunities to learn about farming (Clark and Mahon, 2023).

Thus, participants were able to make judgements about the images, but this was to an often self-acknowledged limited degree. These comments mainly related to ethical judgements, but also included to a lesser extent an evaluation of the farmers' skills in performing some of the practices participants were able to identify. However, some respondents recognised their inability to do this, linked to a lack of knowledge about and experience of modern farming practices. The elements that participants observed in the three images are discussed next.

Participants were able to identify a range of observable outcomes of farming practice in the images. Preference was shown for images of farms that respondents perceived to be clean and tidy. In this case, mud, dirt, and untidiness were linked with an increased likelihood of animal disease, and cleanliness and tidiness with a decreased likelihood. This mirrored responses to the question on the good farm, suggesting that respondents are identifying cleanliness and tidiness as observable results of good farming. Tidiness is a well-documented descriptor of good farming used within farming communities (Burton et al., 2021). However, there is less evidence in the literature of the opposite – dirt and untidiness as an indicator of a less skilled farming. It may simply be the case that this is not seen as an indicator of poor farming practice. However, it may be because of the documented reluctance of farmers to 'call each other out' and discuss what bad farming could be (Sutherland, 2020), whereas the public may well be more prepared to criticise what they understanding to be poor farming practice.

Respondents discussed dirtiness and untidiness most often in the images that showed cattle in, or near, farm buildings. Here it appears that respondents are viewing dirt as "matter out of place" (Douglas, 2002: 44), expressing a feeling that near or inside buildings should not be dirty. It may also be that the 'out of placeness' relates not just to the closeness of dirt to buildings, but to the proximity of dirt to cattle bodies, with the participants expressing a feeling that these animals should not have to stand in mud and dirt. This then relates back to the 'rural idyll' and the perception of agricultural spaces as healthy, problem-free, and safe (Little and Austin, 1996; Hall, 2020), at odds with the presentation of these spaces as dirty and disordered. Furthermore, respondents' perceptions may also be influenced by the fact that each of the

photographs was of a dairy farm, producing milk (as stated in the description of the images in the online survey). Milk has, despite recent bad press related to human health risks (Kongerslev Thorning et al., 2016) and environmental impact (Sandström et al., 2018), a positive image in the eyes of many consumers, with Atkins describing it as possessing a "... blanket of innocent whiteness" (Atkins, 2010: 277). Milk is thus understood by many to be an innately good and natural product, with strong pastoral associations (Atkins, 2007; Clay and Yurco, 2020). The quality of milk is understood to be in part because of its perceived purity and safety (Atkins, 2017). By presenting images specifically of dairy cows in untidy, dirty conditions respondents may be reacting to the proximity of the source of a perceived pure, safe, and healthy product to potential sources of contamination, the mess and dirt of a working farm.

In contrast to the above, there was a relative lack of discussion about cleanliness/dirtiness and tidiness/untidiness in the image without buildings. This may be because dirt in this context was where it should be. Outside, in a field, mud and dirt are perceived as 'natural' and viewed as a part of nature, and not as a potential source of impurity and disease. Indeed, participants considered the environment in photograph B to be the most natural and the animals in the image to be the least likely to become diseased. The responses to this image are similar to the findings of Ditlevsen and Andersen (2020), who built on Douglas (Douglas, 2002; Douglas and Wildavsky, 1983), noting that in Western Europe modern food choices are increasingly motivated by considerations of the naturalness of these products and an avoidance of the side effects of excessive human interference and industrialised food production, even when this incorporates dirty and non-sterile environments (Ditlevsen et al., 2019). Therefore, participants in this investigation may be responding to a desire for the animal products they consume – in this case milk, a product perceived to be particularly pure and safe (Atkins, 2017), to be a produced in a space free of the contamination that more industrialised spaces might confer. Riley (2016) notes that the examples of tidiness described as good farming by farmers in Burton et al. (2008) related to the correct use of machinery in performing agricultural operations, e.g., tidy rows of crops. In this study, respondents linked tidiness to cleanliness, hygiene and animal health. These findings support work by Boogaard et al. (2011) who indicate the importance of hygiene in socially acceptable dairy systems. It also adds to the work of Benard and de Cock Buning (2013) by indicating that both farmers and members of the public value the health of animals kept as livestock.

Participants displayed a preference for animals being outside, if not all the time, then at least able to move freely between indoor and outdoor spaces. Social constructions of agriculture are context dependant, and this preference for being animals outdoors is shown by citizens from multiple western countries, e.g., in the Netherlands and Norway (Boogaard et al., 2010), the United States (Sato et al., 2017), as well as, in the case of this investigation and evidenced by Jackson et al. (2020) the UK. In this investigation animals outside or having the ability to access outside spaces was linked to higher perceived levels of naturalness in the images. This supports work by Jackson et al. (2020), who noted that the UK public display a preference for 'trusting the cow' to make her own choices as to whether to be inside or outside, indicating a preference for the ability for cattle to perform natural behaviours, such as to choose to be where they are at any given time. This is mirrored in the findings of this investigation. The images of cattle housed in buildings had lower sentiments scores and were described using words such as "cramped" and "caged". In this respect it appeared as if respondents were judging the ethical correctness of keeping animals inside, that is, housing cattle inside might be problematic, whereas keeping animals outside is viewed as more appropriate.

The preference for animals being outside also appeared to be linked to the ability of animals to graze, the perceived goodness of a diet based on grass and the ability of an animal to express their natural behaviours. Mentions of grazing, pastures and grass were linked to the idea of a good farm. The positive associations participants had with animals outside is

indicated most clearly by the responses to photograph B. It is, however, worth considering the degree to which photograph B presented an idealised image of cattle and dairy farming to the participants. The image showed blue skies, suggestive of summertime and warm weather, green hills, low animal stocking densities, and the animals in a variety of poses. This reflects the durability of the idea of the rural idyll in which depictions of certain elements of rural landscapes, such as those in photograph B, reinforce public understandings of rural spaces as good (Little and Austin, 1996; Shucksmith, 2018). Nevertheless, it is revealing that some participants reflected on the fact that their mental image of agriculture may not be the same as the images of 'real' farming presented to them in the online survey, with participants especially focusing on changes in the technologies used in agriculture. This indicates an understanding amongst some of the participants that the rural idyll depicted in, for example, certain types of media and advertising, is romanticised.

Overall, respondents were able to identify a range of different characteristics in all the images and describe their preferences for certain observed elements. They were able to demonstrate their agricultural literacy in their ability to evaluate and make ethical judgements about certain elements in the three images. However, gaps in agricultural literacy in terms of the ability to display knowledge about contemporary agriculture were apparent. This was apparent in relation to modern agricultural technologies, and the roles and responsibilities of farmers and agricultural workers. Respondents favoured images that conform to the 'rural idyll', where the farm is a clean, tidy place, in which healthy, safe animals have the choice of where to be and what to eat. Some potentially contradictory dimensions were considered to be good, e.g., the cleanliness and tidiness of agricultural spaces, the desire for healthy animals, and the ability of animals to access to outside spaces. Animal health outcomes may require animals be kept in highly managed, clean indoor spaces, whereas good welfare outcomes may require animals to have access to riskier (in terms of disease), less managed outside spaces. An evaluation of the use of the images and the potential limitations of the methods is discussed next.

### 5.2. Critical reflections on the methodology

This investigation builds on previous work that used images of agriculture to explore public perceptions of food and farming (e.g., Rumble et al., 2014; Busch and Spiller, 2018). Nevertheless, the way that images, such as those used in this investigation, are constructed needs to be reflected on, as images are not neutral, even if they are perceived to be so (Sontag, 1978). Firstly, a single photograph of a farm cannot show the viewer everything about that farm and how it operates. This is an important limitation of this investigation. Photographs of the same cattle taken from different angles will show those animals in different ways (Busch et al., 2017), and the three photographs used in this investigation not only were of three different farms, but showed the animals in those farms in different kinds of location on their respective farms. Thus, an image of the feeding corridor in a barn, which may be cleaner and more ordered than other areas of the farm, might create a very different impression to the viewer when compared with an image of the same barn from the inside of the potentially dirtier, messier animal pens. Secondly, although the images used in this investigation are of real, working dairy farms, they are only partial representations of the total experience of the animals' lives. Variations in daily weather conditions, as well as daily and seasonal variations in the management of cattle (e.g., many dairy cows in the UK are grazed outside in the summer and then housed in the winter) cannot be conveyed in a single image.

Despite these caveats, use of images as a methodological approach is a useful tool for provoking responses from participants. They were able to say something about what they saw in each of the images. Thus, the photographs made animal farming, which can often go unseen, or only partially seen, and is often inaccessible to people, somewhat more visible and accessible to the participants. The photographs also worked

as tools of evocation (Rose, 2008) allowing some participants to recall times they had seen farming activities in the past, or moments when they considered how the food they consumed was produced to aid in their evaluation of farming presented in the images. Furthermore, the images were able to provide large volumes of information to the viewer more succinctly than text, an important consideration in an online survey, in which participants' continued and sustained attention is not guaranteed.

A second aspect of the methodological approach that requires reflection is the use of sentiment analysis. Although increasingly used to analyse social media data (e.g., Oscar et al., 2017; Trovato et al., 2020), it is still a relatively novel approach in rural or agricultural social scientific research. The application of sentiment analysis via the package *sentimentr* in this investigation was useful in illustrating the broad trends in sentiment in the aggregate responses to each of the photographs. However, the sentiment analysis needed to be combined with other types of analysis in order to understand the nuance of participants' responses to the photographs. To this effect, the application of both sentiment analysis and content analysis to the qualitative data and combining this with the results of the statistical analysis of the Likert scale questions was able to provide a more nuanced and in-depth exploration of the participants' responses to the questions surrounding the images. We suggest that future research could apply this mixed methods approach, combining *sentimentr* with other forms of quantitative and qualitative analysis to build a richer understanding of the sentiments expressed by participants in research.

## 6. Conclusions

Participants in this study were able to make sense of and evaluate the images of agriculture presented to them. The degree to which they were able to do this depended, in part, on their agricultural literacy. In general, participants' constructed images of farms conformed to the ideas of the 'rural idyll', a clean, safe, tidy place, in which animals are provided with the choice of where to be and what to eat. Participants favoured constructions of the farmer as a qualified, passionate person who cares about their animals. The findings also suggest that public views of what good animal farming is may be a matter of prioritisation and may require considerations of trade-offs with sometimes seemingly contradictory dimensions of farming considered to be simultaneously good.

The conclusions drawn by Eden et al. (2008) are relevant to these findings. A simplistic response to the differences between public perceptions and the realities of animal farming would be to suggest the creation of more informed and agriculturally literate consumers by promoting an increased flow of information from the agricultural sector to the public, especially in relation to animal agriculture and the practices related to animal health and welfare. However, as Jackson et al. (2022a,b) have noted, this is difficult to put into practice, has to date only met with limited success, and there are unlikely to be simple answers to the complex and ethically challenging questions the public may have. We suggest more active and non-judgemental dialogue between these groups to discuss and articulate the complexity of both farming practices and public thoughts on such practices. These dialogues must acknowledge the diversities of knowledges and concerns held by both the farming industry and members of the public and the need for both groups to learn together to reach acceptable compromises (Jackson et al., 2022a,b), as suggested the proponents of food democracy (Renting et al., 2012; Hassanein, 2003). These conversations do not necessarily have to be via traditional educational routes, as advocated for in the literature on agricultural literacy. Instead, for example, Riley and Robertson (2021, 2022) have suggested farmers' engagement with social media as a powerful tool for documenting, sharing, and reflecting on their work with the non-agricultural publics. However, the images shared are, as discussed in relation to this investigation, unlikely to be entirely neutral and will have likely been carefully chosen and curated by the individual sharing them. Engagement may also take the form of activities such as the UK's 'Open Farm Sunday' events, or via spaces such

as farm shops, which allow for interactions between members of the agricultural and non-agricultural publics.

The findings of this investigation also suggest other avenues for further work. The images used only showed dairy farms. It would be valuable to explore similar questions in relation to both more extensive systems, such as those commonly used to rear sheep and beef cattle, as well as more intensive systems, such as those commonly used to rear poultry and pigs. It would also be valuable to investigate public perceptions of images of the same farm and the same animals but with variations in weather and season, which this investigation was not able to explore, e.g., via webcams or live-streaming technologies in agricultural spaces. Finally, the findings raise a more direct question about farmers themselves – how would farmer perceptions of these images compare to those of the public?

### Authors' contributions

All authors contributed to the study conception and design. Beth Clark and Niamh Mahon conducted material preparation and data analysis. The first draft of the manuscript was written by Niamh Mahon and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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### Consent for publication

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript. For the purpose of open access, the authors have applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission.

### Conflicts of interest

The authors have no conflict of interest to declare.

### Data availability

Data will be made available on request.

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