The Face of the Farm on Social Media: Human, Animal, Plant, or Robot?

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ABSTRACT

On a farm multiple sensors can be deployed to help the farmer with making decisions on the farm. These sensors can also be used to create transparency by giving the data to an AI, who generates post which can be posted on Twitter. The post can be made from different perspectives, namely a human, an animal, a plant, or a robot. In this research we look at to what extend these posters are believed and anthropomorphized. We found no significant difference between the posters, but with help from the open questions we suggest rephrasing the first impression questions and to investigate in adding more depth to the poster's bio, adding more sentiment, and fitting the data used more to the poster. Lastly, we suggested that future research exposed the participants for a longer period of time to the stimuli.

KEY WORDS

Anthropomorphism; social entity; believability

1 INTRODUCTION

On a farm the weather, soil moisture, leaf wetness, crop health, animal health, and more [1]–[3] can be measured by sensors. These sensors help the farmer to make real-time decisions about how to optimize production efficiency, optimize crop quality, and minimize environmental impact. Because the farmer can more precisely use water, fertilizers, pesticides and other chemicals to help with more efficiently growing crops and deal with pest management [3], [4]. The sensors data can come from different sources, such as machines, animals, plants, or the soil.

The sensor data can also be used for another purpose, namely creating transparency. Consumers are increasingly interested in how food is produced [5]. Furthermore, transparency reduces fears and skepticism in consumers [6], [7], and is expected to enhance product quality and improve health and welfare of farm animals [8].

One approach to create transparency would be to have eco-labels on products, to inform consumers about how organic or sustainable the product was produced [1]. Researcher are looking at another possible approach where the data is put into an algorithm, which uses natural language processing and machine learning to produce a social media post to inform the public about the operations on the farm. As the posts are automated, it could be posted from different perspectives, where each poster could be a social entity. The perspective could from the owner from the farm, as the owner would normally see the data from the sensors and would be a logical person to post this data on social media. We also want to investigate other potential posters for a farm. For a cattle farm an animal could be the face of the farm, and for a crop farm a plant could be the perspective to be posted from. On both types of farms robots can be found [2], [9], which gather part of the data. Thus, as the last poster a robot is chosen.

The last three posters could be anthropomorphized. This research aims to find out what the influence of anthropomorphism is, and if one poster is believed more than another. To help find the answer, the following research questions where made:

RQ1: To what extent are the posters believable when posting data on social media about a farm?

We expect that an animal or the plant is believed less than a human or a robot tweeting data of the farm, because the first two would not be able to know the numbers, e.g. how much millimeter it has rained.

RQ2: To what extent are a robot, an animal, or a plant anthropomorphized when people look at their social media account?

Based on previous research, w expected that animals are expect anthropomorphized more than plants [10].

The research questions will be answered by conducting an experiment where participants will see one out of four profiles and answers questions asked about these profiles.

2 RELATED WORKS

2.1 Social entity

A social entity is an entity that is on social media. An entity is generally defined as an object that has a distinct, independent, and self-contained existence, whether hypothetical or real [11]. In this research I'm looking if a person, a robot, an animal, a field, or a plant can be a social entity by looking at anthropomorphism and believability. As AI may become a social entity when anthropomorphized [12]. This entity can become an identity by giving it attributes from which the entity can be distinguished from other entities [13]. Examples of attributes are name, age, social media profile and location.

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2.2 Believability

For this research, we combine two different aspects of believability. On one hand, we look at if participants see the poster as a social entity, or in other words if they believe that the poster actually posted the tweets. On the other hand, we look at credibility. Credibility is synonymous with believability, but has not one clear definition [14]. Credibility is related with trust, as on one hand people need to trust or believe that information is correct for the poster to be credible [15]. On the other hand getting information from a credible user makes the given user trust that the information is correct [14].

Social media visitors are looking for reliable information, for which they need to find credible users. Researchers who looked at credibility of a profile looked at registration age, number of tweets, follower count, friend count, and if the bio is non-empty [16]. In this and other research, of which an overview is given in [14], many look at the data that they can get by scraping data from social media to determine the extent of believability, whilst we look at what extent people believe different posters.

2.3 Anthropomorphism

Anthropomorphizing non-human (agents) happens when people attribute gender, thinking, motivation, intention, emotions, and characteristics to the agent [17]. These non-humans can range from animals to robots to chat-GPT. It can be used to describe actions, and the mental or physical characteristics of the agent. Moreover, anthropomorphism is described as a social response to technology [18]. Not everyone does anthropomorphize on the same level. Children are more likely to anthropomorphize, and even among adults it is not done on the same level. The variables that influence this are dispositional, situational, developmental, and cultural [17].

Treating profiles as human or humanlike versus nonhuman has an impact on whether they are treated as moral agents worthy of respect, or merely as an object [17]. It also influences how people interpret the profiles and their social connection. Kim et al. found by exposing participants to an non-anthropomorphized or an anthropomorphized account that the participants who saw the anthropomorphized account perceived a greater social presence that those who saw the non-anthropomorphized account [19]. Because of this relation between anthropomorphism and social presence we research if our different posters are anthropomorphized to different extents.

Anthropomorphism is looked at in different ways in different contexts. In linguistics, researchers look at the use of who/which, verbs [20], [21], pronouns [21]. Who, he, and she are used for human and gendered terms, and for personal reference. Which and it on the other hand are used for inanimate and ungendered terms and for non-personal references [22]. This is one of the concepts used in our research to determine if the poster is anthropomorphized.

For robots, most studies look at humans interacting with a robot. language, and movement of the robot [23]. Previous research found different conclusions based on the level of anthropomorphism in images. Some researchers have found that the more anthropomorphic an image is, the more credible [24], engaging, interesting and attractive it is [25], [26]. Whilst others did not find evidence in their experiments that this is the case. Furthermore, they did not find evidence that more anthropomorphic images are more credible or reduces uncertainty [27]. So, it is not clear if anthropomorphism is correlated with credibility.

3 METHOD

3.1 Participants

We recruited 33 participants through our social network, LinkedIn, and other CS students from the University of Twente. Of those respondents 3 where excluded, either because they filled in the survey to quickly (less than 100 seconds), or to slowly (more than 25 minutes). The 30 (77% male) remaining participants age's ranging from 16 to 60 (M=27.1, SD=11.3). All the participants use social media, of which 12 (40%) uses Twitter. Of the 30 participants, 9 where in the group who saw the animal poster. The other groups had 7 participants each.

3.2 Experiment design

Twitter would be the platform to place posts on, as it is text-based, which is easier for an AI to generate posts for. The wide audience can be reached, as it is people subscribe to an account, and not to a topic, as is the case with Reddit. Moreover, Twitter has been found to effective in spreading word of mouth [28], which is needed to reach the general public.

The experiment will be a between-group study, with a human, an animal, a plant, and a robot as the posters. Each participant will see one of the four twitter profiles. The tweets for each account is the same, such that the only independent variable is the account features. These features are the profile picture, name, banner, and twitter handle.

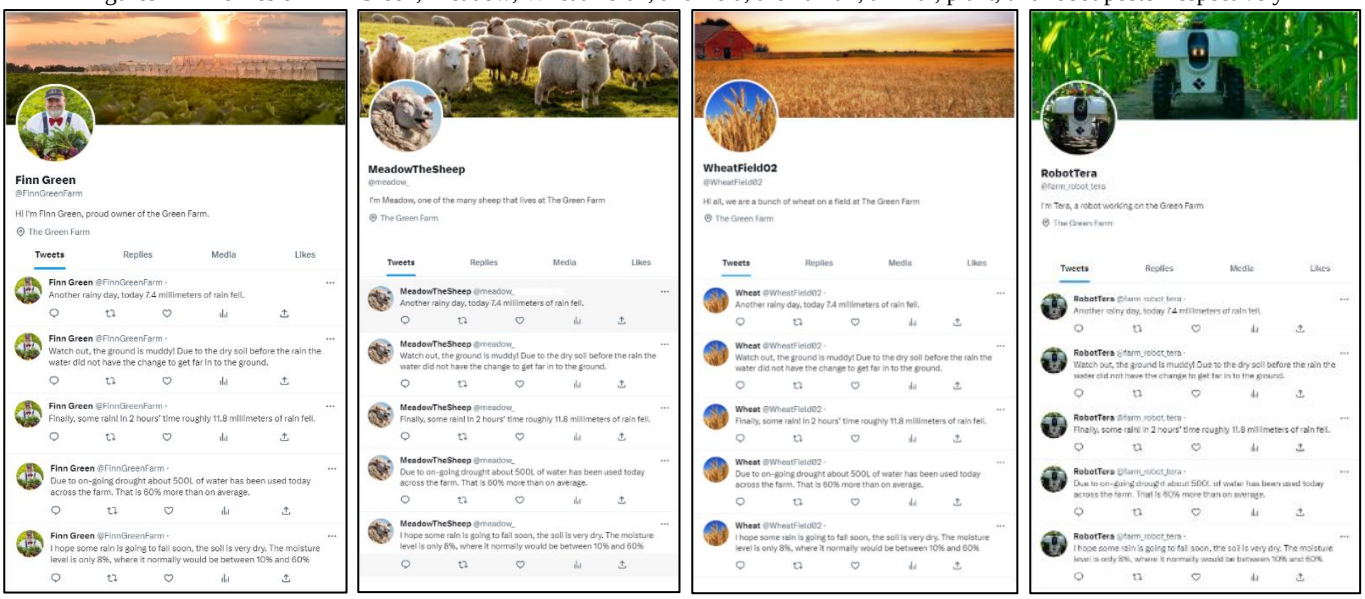
3.3 Materials

Four different Twitter accounts (figure 1-4) were setup, one for each poster. We created the accounts on Twitter to create more realistic stimuli. For each account a profile picture and a banner were made. The same set of human generated tweets were uploaded to each page, where each tweet contains at least one data point. Follower and following count were removed from the stimuli, as that influences the participants perception of credibility [16]. The survey was made in Qualtrics, and the data was exported from it to be analyzed locally.

3.4 Experiment setup

Each participant needed to fill in the afore mentioned survey. The first page is an introduction to the study, which also contains a consent form. On the next three pages they will be show an image of the profile page, along with the questions they need to answer. On the fifth page, participants are asked to give background information, namely gender, age, and social media usage. On the last page they will be debriefed, where they are told what the study is actually about, and they need to give consent one last time before submitting.

Figures 1-4 Profiles of Finn Green, Meadow, WheatFiel02, and Tera, the human, animal, plant, and robot poster respectively



3.5 Experiment procedure

The study was conducted online, as there is no need for in-person interaction. When participants joined the study, they were provided with a link to the survey. Before answering questions about the stimuli, the participants needed to give informed consent. They were told what was expected form them, what data will be collected, how the data is stored, and that they can withdraw at any time. Each participant was asked if they read the given information.

The participants can do the survey in their own time. There is only one survey which was expected to take approximately 15 minutes to complete.

3.6 Measures

For both anthropomorphism and believability there are direct questions in the form of 7-point Likert-scales, and indirect questions in the form of open questions. With the Likert-scales, we aim to find out if there is a difference between the poster, and if there is, between which pair. With the open-ended question, we aim to get more insight into the reasoning of the participants.

To start off, first the participants were asked to give their first impressions of the profile. The answer to this question is used to both measure anthropomorphism and believability. Next, the participants needed to answer a series of 7-point Likert-scale ranging from 1 (strongly disagree) to 7 (strongly agree). They also had the option to say "I don't know".

For anthropomorphism, the participants are asked if they think the poster of the tweets has intentions, has minds of their own, experiences emotions, and has consciousness, which we copied from [29]'s table 1 anthropomorphism category. *Free will* was accidentally taken out. These items have a Cronbach's alpha of 0.854, which is acceptable. Cronbach's alpha tells the internal consistency reliability, or in other words how closely related a set of items are as a group. A Cronbach's alpha above 0.7 is considered acceptable [23].

Believability is also based on four items, namely 'intelligent', 'expert', 'competent', and 'trustworthy'. The participants were asked if they agreed that the poster had these characteristics. The four items are based on the competence and character dimensions of [30] and have a Cronbach's alpha for these items is 0.851, which is acceptable.

For the last question regarding the profiles the participants need to write a reply to one of the tweets. To make it a more Twitter-like experience, they also need to say to which tweet they replied. As before, this question is used to both measure anthropomorphism and believability.

3.7 Data analysis

3.7.1 Likert Scales

To calculate to level of both anthropomorphism and believability, the mean score and standard deviation of all the items of all the participants in one the groups is calculated [23], [31]. Then an ANCOVA test is done to check if there is a significant difference between the four groups with means adjusted age as a covariate.

If there is a significant difference between the groups but not within the groups, a post-hoc ANOVA test with Bonferroni adjustments is done to find out the difference between the independent variables.

3.7.2 Open-ended questions

For the open-ended questions the answers are fitted into different categories by using a coding frame. As the two open-ended questions have different scopes, where one asks about the profile of the poster, and one asks about a single tweet, both questions are annotated separately.

For believability, there is a different coding frame for each open question. The answers can be coded as positive (P), negative (N), or not relevant (NR) according to table 1 for the first impressions and table 2 for the reply to tweets.

Table 1 Coding table for believability in first impression

Category	**Details**
Positive	• Implying that the information in the tweet is real/factual/informative. • Implying that the poster posted the tweets themselves
Negative	• Bot / Automated / Fake Account • Addressing real person behind account • Questioning poster
Not relevant	• Answer is not (clearly) about the profile features or the tweets.

Table 2 Coding table for believability in reply to tweets

Category	**Details**
Positive	• Thanking the poster • Wishing that rain falls • Seeing the poster as a social entity ○ Asking the poster somethings
Negative	• Doubting how the poster would know the statistic or the amount of detail of the statistic
Not relevant	• Reply is not responding to the message of the tweet

For anthropomorphism, in both questions the same coding is used, which is adapted from [18], but the condition of the author giving it a name was left out, as the posters already have a name. An answer is either labeled as anthropomorphic, not anthropomorphic, or not relevant. The answer is anthropomorphic if it contains:

- Emotional states or having a feeling (e.g. *"oh no, poor Meadow")*
- Lifelikeness, such as being alive or having (parts of) a body (e.g. *"I hope you live long")*
- Gender, personality, or having an intention (e.g. "Meadow likes to eat grass")
- Metaphorical ways
- Socially integrated (e.g. "I hope for you it's going to rain soon")

An answer is not relevant when it is not directed towards the poster.

The answers of the people who were in the human group for not annotated for anthropomorphism, because by definition one cannot anthropomorphize a human.

3.8 Annotation procedure

All answers for the open questions were annotated by the author. To calculate the reliability of these annotations, a second coder annotated a random selection of 6 (20%) of the answers, which were all taken from the non-human groups. 6 first impressions and 6 replies to tweets were annotated by both encoders. To determine the interrater reliability, the agreement between the two encoders, Cohen's κ was used.

For believability in the first impressions Cohen's kappa was calculated, giving $\kappa = 0.455$. This indicates a weak level of agreement where 15-35% of annotations are reliable [32].

For anthropomorphism in first impression there was initially a lot of disagreement, as there was a Cohen's kappa of $\kappa = -.250\ (95\%\ CI, -.473\ to\ -.0.27), p < .303$. A negative κ means that there was more disagreement than would be expected if the annotations were done randomly. As a result, the data collected from this coding table for this question is not meaningful [32]. The main point of disagreement was on whether an answer is not relevant, as it was broadly defined.

For both cases the coding table would normally be adjusted, and the answers would be annotated again until an acceptable Cohen's kappa would be reached. Due to time constraints, we were forced to keep working with the current coding tables. Consequently, one should be careful when interpreting the results of these tables.

Normally, with such low kappa's the coding tables would be adjusted and the answers would be annotated again by both the main coder and the second code.

For believability and anthropomorphism in replies to tweets both annotators coded the answers the same way giving κ=1.0.

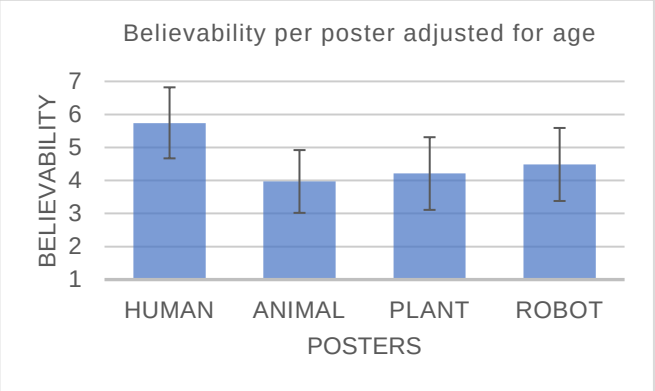
4 RESULTS

4.1 Likert Scales

4.1.1 RQ1: To what extent are a human, a robot, an animal, or a plant believable when posting data on social media about a farm?

An ANCOVA test between the posters with age as a covariate gives $F(3,25)=2.37$, $p=.094$, and $\eta^2=0.22$. The marginal mean and 95% confidence interval are given in figure 5. The p-value of 0.094 suggests that there is not a significant difference in believability between the posters for α=5%. On top of that, age was not significant, as it had a p-value of .190 .

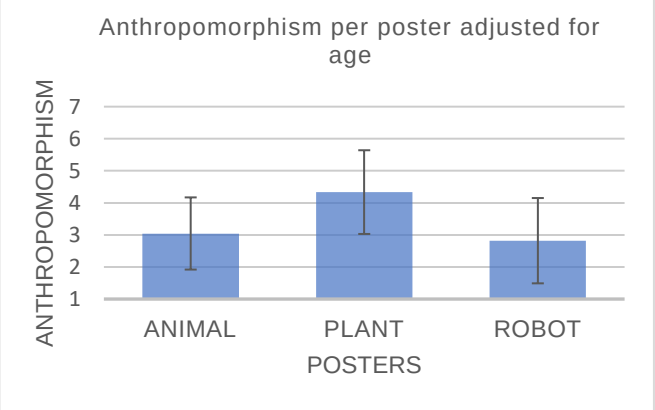
Figure 5 Believability per poster with marginal mean and 95% CI



4.1.2 RQ2: To what extent are a robot, an animal, or a plant anthropomorphized when people look at their social media account?

An ANCOVA test between the posters with age as a covariate gives $F(2,19)=1.69$, $p=.210$, $\eta^2=0.15$, which suggests that there is no significant difference in anthropomorphism between animal, plant, and robot for $\alpha=5\%$. Age also was not significant with a p-value of .131 . The marginal means and 95% confidence interval are reported in figure 6.

Figure 6 Anthropomorphism per poster with marginal mean and 95% CI

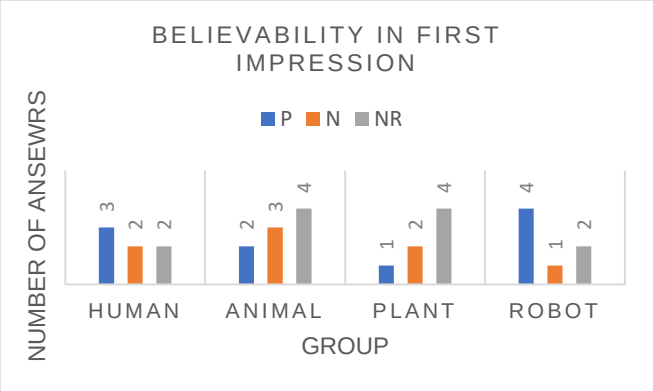


4.2 Open questions

In Figures 7-9 we present an overview of the final annotations of the open questions. In figures 8 and 9 there was only one answer labeled not relevant, which is excluded from the final figures. Additionally, for believability in replies (figure 8) one of the replies was ambiguous, thus also excluded. These responses were in the group who saw the animal poster.

In figure 7 there are multiple cases where answers are not relevant in both categories, which is not ideal as it does not help us to answer the research questions. These answers include *"A lot of wheat*" and *"Farmer"*, which are from people in the plant and animal group respectively. A common factor in these answers is that the participants objectively tell what they see.

Figure 7 Believability in first impressions



Of the answers that were found relevant, most positive answers indicated that they found the poster's Twitter informative. Even if the poster was mentioned, the answer was still related to the tweets as well. The negatively annotated answers where a mix of people who think the account is automated, that there is an individual behind the account, or giving some other reason for doubting the believability of the poster. In the last category was the answers *"Cute robot and why would a robot care about rain? Like what is the purpose of the robot on a farm"* This answer indicates that the participant misses some context about the poster, namely what the robot is doing on the farm. The doubt in these answers indicates that the extent to which the robot is believed can still be increased.

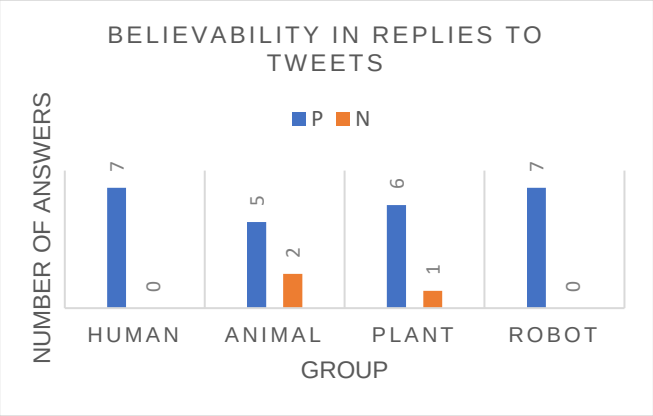
"Cute profile picture, but the actual tweets do not seem to be directly related to the sheep - it does not make me "empathize" or "relate" to the sheep. It seems more like the sheep is doing objective weather reporting, rather than giving personal feelings or accounts"

This response shares a point that a few other negative annotated answers also mentioned. Namely that the poster is doing objective weather updates. As a participant in the human group says *"It seems that he has automated the twitter account to post weather updates. It doesn't feel human"* The tweets are not relatable, as it presents data in the form of tweets. But by not giving any personal feelings some participants get the feeling that the account is automated. Thus the poster is might be believed in terms of believing that the data is correct, but the poster is not seen as a social entity.

"Active on social media, maybe bored? He posts a lot but gets little interaction from his followers. Also, at least in Europe, Twitter is not that popular as in the US, I suspect that a very small amount of people (especially his age) with similar interests will follow him."

As seen in the stimuli, the participants could still see the number of likes, retweets, and comments on a tweet. One participant took this into account when giving their first impression. This suggests that people do look at those attributes, which in this case indicates a negative believability.

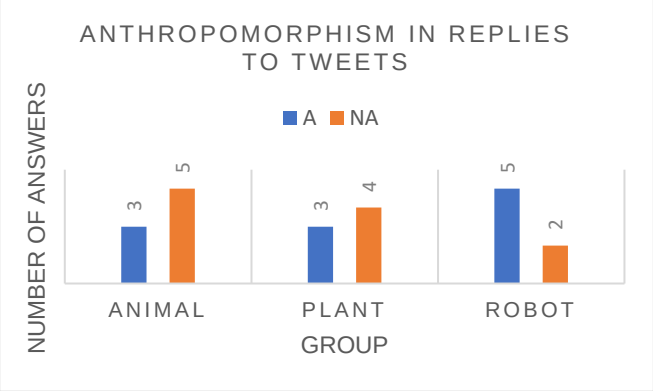
Figure 8 Believability in replies to tweets



As seen in figure 8, the believability in the reply to tweets is mostly positive. There were short answers such as *"nice"* which say little about the extent to which the poster is believed. Answers that talk more about the extent that the posters are believed are the answers where the participant thanks the poster or hopes for the poster that rain will fall soon, as it indicates that the participant believes the data in the tweet is accurate.

However, four people, including the ambiguous reply, did not believe the data in the tweets. They asked the poster what their source is or comment on how accurate the data is, such as *"Quite accurate to know that"* which can be read in a sarcastic tone.

Table 9 Anthropomorphism in replies to tweets



Half of the participants anthropomorphized the poster in their reply, and half of them did not, as seen in figure 9. Of those who did anthropomorphize, most were thanking the poster or hoping for the poster that it will rain. For those who did not anthropomorphize, most talked about the statistic in the tweet or gave a short reaction such as *"Fun!"*.

5 DISCUSSION

5.1 Believability

With the Likert scales, we did not find significant evidence that a human, an animal, a plant, and a robot differ in the extend that they are believed. Which is not in line with our hypothesis. A possible explanation would be the limited number of participants.

Through open-ended questions we found that when the poster is believed, people mention the information in the tweets more than the poster's features. This falls in line with Sandy et al. their findings that content is more important than profile picture and profile summary (bio) in ones judgement of credibility [33]. The believability in the replies to the tweets that the participants wrote was unexpected positive as 25 (86%) was annotated as positive, as opposed to 10 (33%) when asked to give their first impressions. A reason for this could be the high amount of not relevant answers in the first impression question, which is a result participant telling objectively what they saw, instead of giving their opinion about the profile. To prevent this, one could ask the participants opinion of the poster's Twitter, instead of their first impression. In addition, the question could ask the participants to elaborate on their opinions.

For the negatively annotated answers, they are more of a mixed bag. However, this might be skewed due to the high amount of not relevant answers in the first impression question. The reason for bag. Some participants say outright that the poster is a bot, whilst others give more detailed explanation why they do not believe the poster. Interestingly, the detailed answers have often different reasons for not believing the poster. Some talk about that they do not know the purpose of the poster on the farm, some talk about how the poster is not relatable, whilst others talk about the engagement levels on the twitter account. Additionally, some participants questioned how the poster would know the data this accurately. From this mixed bag of answers multiple directions could be taken for feature research. Firstly, the poster's bio could be given more depth. Secondly, to make the poster more relatable, more sentiment could be added to the tweets. However, adding sentiment may have an impact on the credibility of the data, especially with positive sentiment terms. As positive sentiment terms tend to be related to non-credible information [16]. Thirdly, more care should be given to making the stimuli by finding more factors that might influence the credibility of the poster, to make sure that those factors are properly taken care of. Lastly, the data could be fitted more to the poster to try to resolve the issue of people questioning how accurate the data is. For example, and the plants could do use the soil moisture sensor, as its roots are in the ground, thus it would make sense that it knows the moisture level. Whilst a cow as the animal poster could post about the milk production, as it produces milk.

As mentioned before, there was one ambiguous answer, namely *"Very specific measurement of rain! Hope you and your sheep fam are doing great"* The first sentence is interpreted as negative believability, because it says in a sarcastic way that the poster would not know so specifically the amount of rain. The second sentence is however positive believability, as it hopes the sheep and its family is doing great which is seeing the sheep as a social entity. This answer does neither belong in the positive category, the negative category, nor the not relevant category. Thus, the answer needs to be in its own category, or excluded from the results. As it only occurs once, we chose to mention it separately, but with a larger dataset this could become a more prevalent issue.

5.2 Anthropomorphism

Like believability, we did not find any significant evidence that an animal, a plant, and a robot are anthropomorphized to different extends. Again, this does not fall in line with our hypothesis and could be explained by the limited amount of participants.

In the open-ended questions where participants replied to the tweets the most surprising finding was that most positively annotated answers were thanking the poster or wishing for the poster that it will rain, as if the poster is social integrated.

What could be experimented with is exposing participants to the profiles for a prolonged time, as is done in [19]. Participants can build more of a relationship with the poster in this setting, which might have an impact on the level of believability and anthropomorphism, as they are looking at static stimuli in this research.

5.3 Limitations

A limitation is the small number of participants. The smaller the number of participants, the bigger of an effect each answer has. If one out of 7 participants fill in *fully disagree* whilst the others fill in *neither agree nor disagree* it has a bigger effect on the average than when 1 out of 50 participants does it.

Similarly, a smaller number of participants means that the second coder for the coding tables gets less answers to code. Thus, one disagreement has a bigger impact on Cohen's kappa, and thus a bigger impact on the interrater reliability and usability of the coding tables.

Moreover, with a larger sample size the coding tables could be more elaborate. Take positive in table 1, with a larger sample group the two conditions for positive believability could be separated into two categories, giving more insight in the data. This does not work with a small sample size because it risks having only a few participants per category, giving less insight then if we have the current categories.

6 CONCLUSION

To create more transparency on a farm, data gathered from sensors could be posted on social media. This can be done from different perspectives. In this research we looked at to what extend four posters are believed and anthropomorphized. Through Likert-Scales we did not find significant evidence that there is a difference between the posters in terms of believability and anthropomorphism, which might be a result of not having enough participants. With help from the open questions, we suggest rephrasing the first impression questions and to investigate in adding more depth to the poster's bio, adding more sentiment, and fitting the data used more to the poster. Lastly, we suggested that future research exposed the participants for a longer period of time to the stimuli.

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