Cultivating Change: Persuasive Counter-Messaging Strategies to Foster Consumer Acceptance of Cultured Meat

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Abstract

Purpose Conventional meat is linked to environmental and animal welfare-related concerns. Cultured meat, produced in the laboratory from animal cells, has been suggested as an alternative that could overcome these negative consequences of conventional meat, as it can incur fewer environmental impacts and avoid unnecessary animal suffering. Despite these prospective advantages, cultured meat acceptance varies substantially. In this study, we examined whether counter-messages emphasizing environmental damage, animal welfare impacts, and unnatural aspects of conventional meat affect cultured meat acceptance compared to conventional meat. **Design/methodology/approach** The current study employs a quantitative approach, with participants reading one counter-message (environmental, animal welfare, unnaturalness or control). The study follows a 2(meat type: cultured vs. conventional; within-subjects) x 4(essay condition: environmental, animal welfare, unnaturalness, control; between-subjects) mixed MANOVA design, with anticipated eating enjoyment and purchase intent as dependent variables. **Findings** Counter-messages highlighting unnaturalness and negative animal welfare impacts of conventional meat increased cultured meat acceptance. However, counter-messages did not reduce conventional meat acceptance. **Originality** The current study uniquely indicates that counter-messages highlighting unnaturalness and negative animal welfare impacts of conventional meat enhance cultured meat acceptance, suggesting marketers of cultured meat should focus on unnaturalness and animal welfare, rather than environmental impacts, of conventional meat to promote cultured meat.

Keywords: cultured meat, consumer acceptance, persuasive strategies, purchase intent, counter-messaging

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1. Introduction

The meat industry is linked to many environmental and moral concerns (Henchion *et al.*, 2022; Tilman and Clark, 2014), with large amounts of waste, energy, and water consumption involved in meat production placing the industry as one of the largest contributors to climate change (Poore and Nemecek, 2018). Industrial animal agriculture also contributes to significant animal suffering both prior to and during slaughter (Seng and Laporte, 2005), where, despite stipulations requiring the minimization of avoidable pain and stress to animals (Shimshony and Chaudry, 2017), examples show food animals are often handled and slaughtered with little concern for their welfare. Despite increasing awareness of these negative aspects of conventional meat, estimates indicate demand for livestock-derived food will continue to increase over the next 30 years (Komarek *et al.*, 2021). Indeed, research suggests continuing widespread resistance to reducing meat consumption, with many people morally disengaging (i.e., suspending their moral values) from the negative consequences of their diets (Gradidge *et al.*, 2021). Therefore, research on methods to increase acceptance of new sources of animal proteins that may circumvent the negative consequences of conventional meat is greatly needed.

1.1. Cultured meat: A more ethical and sustainable alternative?

Cultured meat refers to meat tissue grown in a laboratory from muscle stem cells (Post, 2012). While debate exists regarding environmental impacts of cultured meat (e.g., the relatively high energy required for cultured meat production, determined through life cycle assessments; Sinke *et al.*, 2023), these concerns are surmountable through utilising renewable energy in cultured meat production (Cai *et al.*, 2024). As such, this relatively novel technique could possibly incur fewer global warming impacts compared to ambitious environmental

targets for conventional meat, (and requires significantly less land (Swartz, 2021), while avoiding unnecessary animal suffering. Specifically, animals are only required at the first stage of the process whereby a sample of their stem cells is collected through a needle biopsy (Post and Hocquette, 2017). A more drastic rate of emissions reductions (Mazac *et al.*, 2024), alongside decreased animal suffering, could thus be achieved by replacing conventional meat with cultured meat. Indeed, whilst multiple alternatives to lower environmental impact of conventional meat have been proposed, including pasture-raised beef (Angerer *et al.*, 2021) and free-range chickens (Higham *et al.*, 2024), these conventional meat alternatives still involve the need to slaughter food animals. This need is largely redundant for cultured meat, as animals are only necessary at the first stage of the process, thus meaning significantly less animal suffering. Furthermore, these conventional meat alternatives may backfire, as they can cause different environmental harms likeland use change, thus increasing carbon dioxide emissions and water consumption, and meaning such land cannot be used for crops (Santeramo *et al.*, 2020).

Indeed, potential benefits of cultured meat have not gone unnoticed. Approval processes are already underway for commercialisation of cultured meats in the UK, Switzerland, Australia and New Zealand (Good Food Institute [GFI], 2024), and cultured meat is already approved for consumption in the US, Singapore and Israel (GFI, 2024), with select suppliers of cultured meat in the US and Singapore. Although supply of cultured meat in the US and Singapore is still extremely low (GFI, 2024), these trends emphasise the growing move towards, and business interest in, cultured meat. Despite delay in becoming a market competitor, and current lack of cost parity with conventional meat (GFI, 2024), consumers may still be willing to pay a premium for protein deemed to have more ethical and sustainable credentials (i.e., cultured meat; Viegas *et al.*, 2014; Wolf and Tonsor, 2017). However, the novel processes involved in manufacturing cultured meat may present distinct

challenges with consumer acceptance and subsequently reduce willingness to buy such products. Indeed, the case study of the US demonstrates some backlash to cultured meat, including legal cases around labelling of cultured meat and proposed bans on cultured meat in a few states (GFI, 2024). Thus, ensuring consumer acceptance of cultured meat is crucial for the industry's success. Several recent reviews have therefore sought to identify key determinants of cultured meat acceptance, emphasising individual differences like access to information, ethical stances, and intrinsic factors (Kouarfaté and Durif, 2023), alongside contextual factors, including cultured meat properties and product labelling (Hanan *et al.*, 2024). We therefore discuss consumer perceptions of cultured meat and challenges for cultured meat acceptance next, before exploring possible strategies to promote cultured meat acceptance.

1.2. Consumer perceptions of cultured meat

Although consumers appear generally aware of the potential benefits of cultured meat, perceiving it as more environmentally sustainable and less harmful to animals (Bekker *et al.*, 2017; Laestadius, 2015), less likely to carry zoonoses or food-borne illnesses (Wilks and Phillips, 2017), and enabling more egalitarian access to meat products (Verbeke *et al.*, 2015) compared to conventional meat, consumers do not always accept cultured meat willingly. Reports on percentages of acceptance and willingness to consume cultured meat vary to a great extent (for reviews, see Ahmad *et al.*, 2023; Bryant and Barnett, 2018, 2020; Hanan *et al.*, 2024; Hartmann and Siegrist, 2017): Whilst some studies suggest a relatively high percentage of consumers would try cultured meat (around 65% in the U.S., Wilks and Phillips, 2017; 54% in Italy; Mancini and Antonioli, 2019), others indicate a low percentage (24% in Belgium; Verbeke *et al.*, 2015). Such variability in perceptions of cultured meat may occur due to methodological differences between studies; for example, by using different terms for cultured meat ("in-vitro", "clean", "synthetic"; Bryant and Barnett, 2018, 2020).

Indeed, previous research has demonstrated that "clean meat" and "animal-free meat" encourage more positive attitudes towards cultured meat than "lab-grown meat" (Ahmad *et al.*, 2023; Bryant and Barnett, 2019). These findings could be attributed to the perceived lack of "naturalness" of cultured meat (Bryant *et al.*, 2019). Qualitative data suggests perceived "unnaturalness" and disgust are the most common reactions to cultured meat (Verbeke *et al.*, 2015), and the former negatively predicts cultured meat consumption intentions regardless of whether people are familiar with cultured meat (Weinrich *et al.*, 2020). In a further study by Siegrist *et al.* (2018), t perceived unnaturalness of cultured meat reduced willingness to consume and buy cultured meat both directly and indirectly (through eliciting disgust). The influence of perceived unnaturalness seems so strong that some studies have shown consumers dislike cultured meats more when labelled with terms likely to evoke perceived 'unnaturalness' ("lab-grown", "synthetic", "artificial meat"; Asioli *et al.*, 2022), especially among individuals high in food neophobia (uncertainty about consuming new foods; Califano *et al.*, 2023).

1.3. Persuasive strategies to promote cultured meat acceptance

Many studies have investigated possible strategies to persuade consumers to favour cultured meat over conventional products. Some have highlighted the potential *benefits* (i.e., environmental and animal welfare) of cultured meat, though these strategies have been found to backfire. For example, reading about environmental and animal welfare benefits of cultured (vs. organic) ground beef can cause cultured ground beef to be deemed more unnatural, in turn decreasing willingness to consume cultured ground beef (vs. organic; Siegrist *et al.*, 2018). Other research indicates persuasive messaging stating cultured meat is natural does not increase acceptance nor positive attitudes and beliefs concerning cultured meat (Bryant *et al.*, 2019). Instead, persuading participants *conventional* meat is *unnatural* (Bryant *et al.*, 2019) was found most effective. This approach increased willingness to pay for some cultured meats

(vs. control) and caused more positive attitudes and beliefs about cultured meat (vs. alternative persuasive messages).

Thus, persuasive attempts which leverage *negative consequences of conventional meat* could be more effective at improving perceptions of cultured meat, compared to persuasion about the potential *benefits of cultured meat*. Such a "counter-messaging" approach was shown to foster cultured meat acceptance (Baum *et al.*, 2022), whereby presenting information about the negative consequences of conventional meat (either harm to animal welfare or the environment, vs. control) enhanced cultured meat acceptance. Note there was no significant difference in cultured meat acceptance depending on the focus of the counter-message (animal welfare or environment),

Taken together, findings on counter-messaging in the context of cultured meat so far indicate that counter-messaging, whether based on negative impacts of conventional meat (Baum *et al.*, 2022), or unnaturalness of conventional meat (Bryant *et al.*, 2019), can effectively enhance cultured meat acceptance. Additionally, there was no difference in effectiveness depending on whether the counter-message focuses on environmental or animal welfare negative impacts (Baum *et al.*, 2022). However, while recent results suggest that challenging the notion that 'natural is good' increases cultured meat acceptance (Arango *et al.*, 2023), and that counter-messaging based on unnaturalness enhances cultured meat acceptance in some consumers (Arango *et al.*, 2024), research has not yet tested if unnaturalness is superior, or equivalent, to environmental and animal welfare counter-messages in enhancing cultured meat acceptance. As such, it is currently unclear whether campaigns to enhance cultured meat acceptance should focus on counter-messaging referring to unnaturalness or referring to negative environmental or welfare impacts of conventional meat. Thus, the current research primarily aims to directly compare these counter-messages (unnaturalness vs. environmental consequences vs. animal welfare consequences vs. control) for the first time to

determine which are most effective at improving cultured meat acceptance, whereby cultured meat acceptance is measured through anticipated eating enjoyment and purchase intent for cultured meat. We therefore ask: What is the most effective counter-message to enhance cultured meat acceptance (**RQ1**)? In line with Baum *et al.* (2022) and Bryant *et al.* (2019), we hypothesise that unnaturalness, environmental and animal welfare counter-messages (vs. a control text), will cause greater anticipated eating enjoyment of (**a**) and higher purchase intent for (**b**) cultured meats (**H1**). We do not make hypotheses regarding expected differences between the unnaturalness, environmental and animal welfare counter-messages, leaving this exploratory.

Expanding on Baum *et al.* (2022), Bryant *et al.* (2019) and Arango *et al.* (2023, 2024), we also uniquely measure whether counter-messages impact *conventional* meat acceptance, and therefore whether counter-messaging both enhances cultured meat acceptance *and* decreases conventional meat acceptance. This ties into our aim for cultured meat to *replace* conventional meat, rather than for cultured meat to be *an addition to* conventional meat, thus maximising potential animal welfare and environmental benefits of cultured meat consumption. Thus, the current research secondarily aims to compare counter-messages (unnaturalness vs. environmental consequences vs. animal welfare consequences vs. control) for the first time to determine if any are effective (and if so, which are most effective) in *decreasing conventional meat acceptance*, whereby conventional meat acceptance is measured through anticipated eating enjoyment and purchase intent for conventional meat. We therefore also ask: Does counter-messaging decrease conventional meat acceptance (**RQ2**)?

2. Material and Methods

2.1. Participants

Four-hundred participants from the UK were recruited via Prolific in November 2021. Following our pre-registration (available at https://osf.io/n69md/?view_only=32b9d19b97cb4abe9af862cbce501306), 88 participants were excluded as they indicated they were unable to consume meat, another 14 participants were excluded for failing to give at least one correct answer to the control questions (Section 2.4.5)[1] and, as our analyses control for participant sex (defined in this paper as a category assigned at birth based on biological attributes and measured by asking participants to "please indicate your sex"; Section 3), an additional six participants were excluded either for selecting "other" (n=5) or indicating they "prefer not to say" (n=1). These exclusions left a final sample of 292 participants (all 18+; 64% women, M_{age}= 31.81, SD_{age}= 11.51; all meat-consumers). We only recruited meat-consumers as our target audience, as the secondary aim of the current paper is to reduce conventional meat acceptance. Additionally, to try to alleviate the negative consequences of conventional meat, the paper aims to enhance cultured meat acceptance within meat-consumers, with the goal of cultured meat ultimately replacing conventional meat as a way to possibly reduce harm to the environment and animal welfare. No participants provided partial data. Our sample exceeds the minimum sample size required (N=179) to detect a medium-sized effect per a G*Power analysis for a repeated measures (within-between interaction) MANOVA (effect size f=.25, α=.05, power of .8, four groups, two measurements). Participants were reimbursed £1.25 each for their time via Prolific. Our sample consisted of 65 participants for the environmental essay, 78 participants for unnaturalness , 72 participants for animal welfare and 77 participants for control.

2.2. Design

This study constitutes a 2(meat type: cultured vs. conventional; within-subjects) x 4(essay condition: environmental, animal welfare, unnaturalness, and control; between-subjects) mixed MANOVA design, with anticipated eating enjoyment and purchase intent as

the dependent variables (DVs). Participant sex is included as a covariate for all analyses (Section 3). This research received ethical approval in August 2021 from **(undisclosed to conform with blind peer-review)** University (ethics code: **blinded for review**).

2.3. Procedure

Participants were directed to Qualtrics from Prolific. They first read the participant information sheet and gave their informed consent to take part. Participants were then informed that the study explores food preferences and that they would read a short essay and answer questions about it afterwards. Participants were then randomised into one of the four essay conditions (presented with related images to try to increase persuasiveness): unnaturalness, animal welfare, or control (Supplementary Materials A). Each essay was similar in terms of numbers of words and finished with a short paragraph briefly presenting cultured meat as a potential solution to the negative consequence described. After this, participants were provided with a broader definition of cultured meat as "*meat produced within the laboratory from animal cells*", before being randomly presented with a picture of a type of meat (ground beef, duck breast, pork, chicken breast or steak) either labelled as "ground beef", "duck breast", "pork", "chicken breast" or "steak" (conventional meat), or using identical labels but with "cultured" in front i.e., "cultured ground beef", "cultured duck breast", "cultured pork", "cultured chicken breast" or "cultured steak" (cultured meat). This process repeated until participants saw all meats, with participants indicating their eating enjoyment and purchase intent for each. Participants then answered the three control questions about their essay followed by the 11 manipulation check items. Finally, participants provided demographic details (age, sex, whether they were unable to consume meat for any reason), before being debriefed and redirected back to Prolific to receive reimbursement.

2.4. Materials and Measures

2.4.1. Essays

We adapted essays from Palomo-Vélez *et al.* (2018) for the environmental, animal welfare, and control essays (Supplementary Materials A). These essays were successfully piloted for Study 2 in Palomo-Vélez *et al.* (2018). While the versions used here were adapted to fit the aims of the present study, the original arguments regarding environmental and animal welfare impacts of conventional meat remain the same, giving us confidence the essays would work as intended within the current study. The control essay did not discuss meat at all and instead presented participants with a neutral and non-emotive essay on the 1980 Winter Olympics.. The remaining essay about unnaturalness was devised by the current authors for this study, and followed the same format as the other essays to ensure consistency in length and detail. .All essays were successfully piloted for the current study (N=70; all 18+; M_{age}=28.06, SD_{age}=8.48; 58.57% women; Supplementary Materials B).

2.4.2. Images

Participants saw five separate images for ground beef, duck breast, pork, chicken breast, and steak (Supplementary Materials C). To differentiate between cultured and conventional meats, meats were labelled either as "ground beef", "duck breast", "pork", "chicken breast" and "steak" (conventional meat), or had the word "cultured" included at the front of the labels i.e., "cultured ground beef", "cultured duck breast", "cultured pork", "cultured chicken breast" and "cultured steak", as participants could not otherwise have been expected to assume these were cultured meats. We did not use the word "conventional" in front of the conventional meat labels, as we assumed participants would expect the meat to be conventional by default, and use of the word "conventional" may have caused confusion. Iidentical images were used for each meat regardless of its label as "cultured" or not, to ensure differences in perceptions of cultured vs. conventional meat did not arise from responses to different images.

2.4.3. Eating enjoyment

Eating enjoyment was measured for all meats through a single-item question asked after viewing the product: "*How much would you enjoy eating this product?*" This item was measured on a scale from zero "*not at all*" to six "*very much*" (Palomo-Vélez *et al.*, 2018)

2.4.4. Purchase intent

Purchase intent was measured for all meats through a single-item question asked after viewing the product: "*If you were in the grocery store right now, how likely is it that you would buy this product?*" This item was measured on a scale from zero *"very unlikely*" to six "*very likely*" (Palomo-Vélez *et al.*, 2018).

2.4.5. Control questions

To measure memory for and comprehension of the essays, participants were asked three multiple-choice control questions about their essay (Supplementary Materials D). Each question had five possible answers with only one correct answer. Participants were excluded if they failed to answer at least one question correctly, with 14 participants being excluded for this reason.

2.4.6. Manipulation checks

Participants were asked 11 items to check effective manipulation of the essays (Supplementary Materials E). All questions were single-items on visual analogue scale from zero to 100. The manipulation check questions were presented in random order to prevent order effects.

3. Results

The dataset is available at: https://osf.io/dspbg/?view_only=fcc3b9d69cc4485ba06c3cf1a5af49c4. To test whether the counter-messages enhance cultured meat acceptance (**H1**) and decrease conventional meat acceptance, a 2(meat type: conventional meat vs. cultured meat; within-subjects) x 4(essay condition: environmental vs. natural vs. animal welfare vs. control; between-subjects) mixed

MANCOVA was conducted on eating enjoyment and purchase intent, including participant sex as a covariate. All statistical assumptions for this MANCOVA were met or resolved. Univariate and multivariate outliers were present, but the analyses including outliers are reported to represent the true dataset. Participant sex was statistically controlled for since men typically have more positive attitudes toward (conventional) meat and consume more (conventional) meat than women do (Gossard and York, 2003; Kiefer *et al.*, 2005; Prättälä *et al.*, 2007). Therefore, including participant sex as a covariate enables any relationship between participant sex and perceptions of meat to be partialled out, increasing power of the analysis (Tabachnick and Fidell, 2019). Participant sex was dummy coded, with women as the reference group (coded as zero). Age was not included as a covariate, as the literature does not indicate a consistent relationship between age and perceptions of meat (i.e., significant findings in different directions, and non-significant findings; Gradidge *et al.*, 2021), and covariates should only be included within experimental designs where there is a statistically significant, or theoretically-informed, relationship between the covariate and the DV to avoid overfitting (Tabachnick and Fidell, 2019).

This analysis was conducted as a MANOVA rather than two separate ANOVAs, due to strong significant correlations between eating enjoyment and purchase intent across essay conditions both for conventional meat, $.78 \leq rs \leq .88$, $ps < .001$, and cultured meat, $.84 \leq rs \leq .92$, $ps < .001$, as assessed through Pearson correlations. Specifically, when there are strong theoretical and/or statistical relationships between DVs, a MANOVA should be conducted instead of separate ANOVAs to statistically account for this underlying relationship (Field, 2018; Tabachnick and Fidell, 2019). Additionally, MANOVA controls for Type 1 error in the multivariate findings, unlike individual ANOVAs (Field, 2018; Tabachnick and Fidell, 2019). Where multivariate main effects or interactions are significant, these findings are followed up

with univariate ANCOVAs, followed by *post hoc* pairwise comparisons with Bonferroni adjustment for significant univariate interactions.

A one-way (essay condition) between-subjects MANCOVA on the 11 manipulation check items was also conducted, to check whether the counter-messages effectively manipulated their intended variables (findings reported in Supplementary Materials F). These manipulation checks revealed the essays to work as expected.

3.1. Testing H1: Effect of counter-messaging condition on eating enjoyment and purchase intent for conventional and cultured meats

3.1.1. Multivariate effects of essay condition and meat type on the combined DVs

The MANCOVA revealed a significant medium-sized two-way interaction between meat type and essay condition on the combined DVs, $F(6, 574) = 5.37$, $p < .001$, $\eta^2_p = .05$. There was also a significant large-sized main effect of meat type on the combined DVs, $F(2, 286) = 28.95$, $p = .01$, $\eta^2_p = .17$. Additionally, there was a significant small-sized main effect of participant sex on the combined DVs, $F(2, 286) = 3.61$, $p = .03$, $\eta^2_p = .03$. There was no significant main effect of essay condition on the combined DVs, $F(6, 574) = .87$, $p = .52$, $\eta^2_p = .01$. The significant multivariate interaction and main effects are followed up with univariate ANCOVAs on each DV (eating enjoyment and purchase intent) individually below.

3.1.2. Univariate effects on eating enjoyment of conventional and cultured meats

There was a significant large-sized main effect of meat type on eating enjoyment, $F(1, 287) = 56.28$, $p < .001$, $\eta^2_p = .16$, whereby people anticipated enjoying eating conventional meat (M=4.77, SE=.07) more than cultured meat (M=4.05, SE=.09). However, this main effect was qualified by a significant medium-sized two-way interaction between meat type and essay condition on eating enjoyment, $F(3, 287) = 8.39$, $p < .001$, $\eta^2_p = .08$. *Post hoc* pairwise comparisons for this interaction revealed that, partly supporting **H1a,** both the unnaturalness

(*M*=4.34, *SE*=.17), p = .01, and the animal welfare (*M*=4.23, *SE*=.17), p = .04, essays caused significantly greater eating enjoyment for cultured meat vs. control (*M*=3.56, *SE*=.17). However, inconsistent with **H1a,** the environmental (*M*=4.06, *SE*=.18) essay did not significantly differ to control in eating enjoyment of cultured meat, p = .27. There were no significant differences in eating enjoyment for *conventional* meat between the animal welfare (*M*=4.51, *SE*=.15), environmental (*M*=4.81, *SE*=.15) and unnaturalness (*M*=4.84, *SE*=.14) essays vs. control (*M*=4.91, *SE*=.14), ps ≥ 1. Partly in line with the significant main effect of meat type, conventional meat was rated as higher in eating enjoyment compared to cultured meat in the environmental, $p < .001$, unnaturalness, p = .002, and control conditions, $p < .001$, although there was no significant difference in eating enjoyment for cultured versus conventional meat in the animal welfare condition, p = .09 (Figure 1). Finally, there was a significant small-sized main effect of participant sex on eating enjoyment, $F(1, 287) = 6.81$, $p = .01$, $\eta^2_p = .02$, whereby men enjoyed eating both conventional, B = .32, SE = .15, p = .04, and cultured meat, B = .43, SE = .18, p = .02, more than women.

Insert Figure 1 here

3.1.3. Univariate effects on purchase intent of conventional and cultured meats

There was a significant medium-to-large-sized main effect of meat type on purchase intent, $F(1, 287) = 36.67$, $p < .001$, $\eta^2_p = .11$, whereby people were more willing to purchase conventional meat (*M*=4.21, *SE*=.08) vs. cultured meat (*M*=3.6, *SE*=.09). However, this main effect was qualified by a significant medium-sized two-way interaction between meat type and essay condition on purchase intent, $F(3, 287) = 7.18$, $p < .001$, $\eta^2_p = .07$. *Post hoc* pairwise comparisons for this interaction revealed that, partly supporting **H1b,** both the unnaturalness (*M*=3.83, *SE*=.18), p = .02, and the animal welfare (*M*=3.86, *SE*=.18), p = .01, essays caused

significantly greater purchase intent for cultured meat vs. control (M=3.07, SE=.18). However, inconsistent with **H1b,** the environmental (M=3.62, SE=.19) essay did not significantly differ to control in purchase intent for cultured meat, p = .22. There were no significant differences in purchase intent for conventional meat between animal welfare (M=3.88, SE=.16), environmental (M=4.3, SE=.17) and unnaturalness (M=4.39, SE=.15) vs. control (M=4.28, SE=.15), ps ≥ 1. Partly in line with the significant main effect of meat type, people were more willing to purchase conventional meat compared to cultured meat in the environmental, p < .001, unnaturalness, p = .002, and control conditions, p < .001, although there was no significant difference in purchase intent for cultured vs. conventional meat in the animal welfare condition, p = .9 (Figure 2). Finally, there was a significant small-sized main effect of participant sex on purchase intent, $F(1,\ 287) = 6.47, p = .01,\ \eta^2_p = .02$, whereby men were more willing to purchase cultured meat, B = .49, SE = .19, p = .01, than women. However, there was no significant difference between men and women in their willingness to purchase conventional meat, B = .27, SE = .16, p = .1.

Insert Figure 2 here

4. Discussion

4.1. Discussion of findings

The current research primarily aims to explore which counter-messages (environmental, animal welfare, or unnaturalness) are most effective for enhancing eating enjoyment and purchase intent for cultured meat. The results of the current study indicate counter-messages highlighting unnaturalness and negative animal welfare impacts of conventional meat enhanced eating enjoyment and purchase intent for cultured meat. Thus, **H1** was partially supported and partly consistent with previous literature (Arango *et al.*, 2024;

Baum *et al.*, 2022; Bryant *et al.*, 2019). However, unexpectedly, the environmental essay did not enhance eating enjoyment or purchase intent for cultured meat, which is inconsistent with **H1** and disagrees with Baum *et al.* (2022), who found benefits of counter-messaging based on environmental impacts. Additionally, regarding the secondary aim of the current study (to test whether counter-messaging decreases conventional meat acceptance), none of the counter-messages were superior to control in reducing eating enjoyment or purchase intent for conventional meat. Finally, conventional meat was still rated higher on both eating enjoyment and purchase intent compared to cultured meat within the environmental, unnaturalness, and control conditions, although there was no gap within the animal welfare condition.

While we observed positive effects for the unnaturalness and animal welfare conditions on cultured meat acceptance, the lack of significant effects in response to the environmental essay on cultured meat acceptance could be explained by the hypothetical nature of the study. That is, by not having had a chance to taste the product (Fesenfeld *et al.*, 2024; Su *et al.*, 2024), the hypothetical environmental counter-messaging alone may not have fully resonated with consumers, and instead real-world sensory interactions with cultured meat may be necessary to achieve cultured meat acceptance through environmental counter-messaging. However, this does not clarify why the animal welfare and unnaturalness essays enhanced cultured meat acceptance, as these essays were also hypothetical. As perceived credibility of each essay was not measured within the current study, it is also possible the environmental counter-message was not perceived as credible, thus explaining the lack of significant effects on cultured meat acceptance as perceived credibility can impact perceptions of cultured meat (Leong, 2024).

Alternatively, the lack of a significant effect on eating enjoyment in response to the environmental essay could be attributed to the possibly tenuous link between environmental

impact itself and taste. Consumers' enjoyment of food, including meat substitutes, is often influenced by factors like flavour, texture, and sensory experiences (Fesenfeld *et al.*, 2024), which are more immediate and salient than long-term environmental consequences. The potential environmental benefits of cultured meat, while important from a sustainability perspective, may not have a direct and immediate impact on the sensory pleasure derived from eating. As such, the environmental argument alone may not be sufficient to sway consumers towards cultured meat. Further, the lack of effect of the environmental essay on purchase intent for cultured meat might be explained by feelings that personal meat consumption plays a limited role in the environmental issues arising from conventional meat, resulting in reduced motivation to change meat consumption (i.e., diffusion of responsibility; Catellani *et al.*, 2022; Macdiarmid *et al.*, 2016; Truelove and Parks, 2012; van den Boom *et al.*, 2023). However, these considerations could also be applied to animal welfare (van den Boom *et al.*, 2023), given the potential disconnect between the sensory experience of eating meat and ethical concerns associated with slaughterhouse practices. That is, consumers may not feel personally accountable for harms to animal welfare arising from meat consumption. Understanding why highlighting the negative animal welfare, but not the environmental, impacts of conventional meat enhances cultured meat acceptance, warrants further investigation.

The inability of all counter-messages to reduce eating enjoyment and purchase intent for conventional meat may be due to strong psychological commitment to conventional meat. For example, people typically experience meat-related cognitive dissonance (Gradidge *et al.*, 2021; Rothgerber, 2020), whereby people do not want to harm animals but yet also want to consume meat. As conventional meat requires harm to animals, through slaughter, people thus experience a feeling of conflict (cognitive dissonance), which is inherently felt as threatening and unpleasant (Gradidge *et al.*, 2021; Rothgerber, 2020). Any information presented to

people on the negative sides of conventional meat therefore tends to elicit this feeling of threat, with most people resolving this threat through psychological mechanisms like denial of animal sentience (Gradidge *et al.*, 2021), rather than through behaviour change (e.g., no longer consuming conventional meat). Our current study thus reinforces these previous findings by emphasising the difficulties in reducing conventional meat acceptance, and uniquely demonstrates that enhancing cultured meat acceptance does not necessarily correspond to a reduction in conventional meat acceptance. Such a finding should be considered in future research, whereby psychological acceptance of cultured meat as a *replacement* for conventional meat should be measured, rather than psychological acceptance of cultured meat as an *addition to* conventional meat. Overall, our findings indicate animal welfare or climate change organisations, cultured meat marketers, and any other individuals interested in enhancing cultured meat consumption (e.g., consumer psychologists) should appeal to the unnaturalness of, or negative animal welfare implications of, conventional meat to enhance eating enjoyment and purchase intent for cultured meat. However, aiming to reduce eating enjoyment and purchase intent for *conventional* meat proves more difficult, as presenting information on the unnaturalness, and negative animal welfare and environmental implications of conventional meat failed to change perceptions on conventional meat. Even where eating enjoyment and purchase intent for cultured meat is enhanced, people still prefer (i.e., have greater eating enjoyment and purchase intent for) conventional meat compared to cultured meat, although discussing the negative animal welfare implications of conventional meat may reduce this gap.

While exploring sex effects was not the aim of this study, our results showed that men and women differed on their eating enjoyment for cultured and conventional meat, and their purchase intent for cultured meat (though not conventional meat). These findings indicate men may be more receptive to cultured meat than women (due to greater eating enjoyment

and purchase intent of cultured meat), although paradoxically men may also be more invested in conventional meat (due to greater eating enjoyment of conventional meat, agreeing with previous research e.g., Camilleri *et al.*, 2024; Hopwood *et al.*, 2024) compared to women. As such, these findings suggest preferences for conventional vs. cultured meat are not mutually exclusive (i.e., preferring one meat over the other), but may instead be linked to one's perceptions of *all* meats, whereby men enjoy consuming (conventional or cultured) meat more than women.

4.2. Limitations

This study is not exempt from limitations. First, given the differences of our results with those reported in Baum *et al.* (2022), whereby environmental messages increased cultured meat acceptance, the lack of effect of the environmental essay in the current study could be attributed to methodological limitations. While the current research opted for single-item measures of anticipated eating enjoyment and purchase intent, Baum *et al.* (2022) developed a composite measure of cultured meat acceptance encompassing seven items related to willingness to try, purchase, or pay more. The use of single-use measures thus may have provided a limited view of our DVs. Additionally, Baum *et al.* (2022) measured cultured meat acceptance pre- as well as post- intervention, whereas the present study only measured post-essay; While we piloted the essays, the absence of pre-essay measures limits our ability to assess baseline perceptions towards cultured and conventional meat. Thus, it is challenging to determine how much the essays influenced responses, as we cannot compare changes in perceptions or intentions from before to after reading the essays. On a related note, we also did not measure perceived credibility or persuasiveness of the essays, so participants may not have believed the content of the essays, thus reducing psychological impacts.

Further, the information presented to participants in the present study varied in content and complexity to the information presented to participants by Baum *et al.* (2022). Whilst

Baum *et al.* (2022) provided information based on a literature review with a neutral framing, we adapted essays from Palomo-Vélez *et al.* (2018), with a focus on evoking specific emotions and challenging ingrained beliefs about conventional meat. The essays in the current study thus employed stronger language and imagery to highlight the negative aspects of conventional meat. Nonetheless, while the stronger language and imagery may have influenced participant responses, it is important to test effectiveness of these negatively framed messages to determine their impact on cultured meat acceptance. More broadly, while the current study utilised both informational text and images, future research could utilise different formats, including multimedia (e.g., videos or virtual reality) or in-person interaction with the products (i.e., to enable taste; Fesenfeld *et al.*, 2024; Su *et al.*, 2024). Doing so may enable a more ecologically valid assessment of how different messaging strategies and approaches influence consumer acceptance.

Thirdly, only collecting age and sex demographics means representativeness of the current sample (e.g., in terms of ethnicity) cannot be assessed. In addition, the present study did not measure political affiliation or identity, factors which may influence dietary habits and attitudes towards cultured meat. There were also some limitations in diversity of the current sample, with participants being from the UK, meaning the findings may generalise cross-culturally. Future studies should recruit an international sample to compare how different cultures respond to counter-messages about conventional meat.

While the present study was conducted during a time when cultured meat was still relatively unknown to the public (2021), some participants may have heard about it before and held preconceived notions (prior knowledge), which could have influenced the results. Indeed, prior knowledge is a key variable in numerous studies exploring cultured meat acceptance, whereby participants with prior knowledge of cultured meat are less likely to change their perceptions after being exposed to information about its benefits, and those with

less prior knowledge are more open to a change in beliefs (Bekker *et al.*, 2017; Baum *et al.*, 2022; Chen *et al.*, 2023).

Finally, the current research only explored short-term impacts of counter-messaging on cultured meat acceptance. As such, it remains unclear whether enhanced cultured meat acceptance would remain, over time or whether repeated exposure to counter-messages would be necessary to sustain cultured meat acceptance. Future research should address this limitation by exploring the long-term effects of counter-messaging on cultured meat acceptance.

4.3. Conclusions

Whilst previous research has explored different counter-messages which enhance cultured meat acceptance (unnaturalness; Arango *et al.*, 2024; Bryant *et al.*, 2019; animal welfare and environment; Baum *et al.*, 2022), this study is the first to our knowledge to directly compare these counter-messages to see which are most effective in increasing cultured meat acceptance. Additionally, this study is also the first to explore the impact of these counter-messages on *conventional* meat acceptance, to determine if these counter-messages enhance cultured meat acceptance *and* reduce conventional meat acceptance. Our findings indicate messages highlighting the unnaturalness and negative animal welfare impacts of conventional meat enhance cultured meat acceptance. However, the current findings reveal that all counter-messages are ineffective at reducing conventional meat acceptance. The paper has implications for animal welfare, the environment and broader consumer psychology. Whilst progress is still required to make cultured meat more widely accessible and affordable, this study informs strategies to enhance cultured meat acceptance.

5. Endnotes

1Due to researcher error in the Qualtrics programming, one of the control questions associated with the natural essay did not have a correct alternative answer (i.e., cows' daily production of milk is 25-50 liters). Nevertheless, most participants correctly chose the closest alternative (i.e., cows' daily production of milk is 20-25 liters per day). Therefore, we decided not to use this particular control question as a criterion for participant exclusion.

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