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# Understanding the effect of social norms and environmental messaging on influencing acceptance of cultivated meat in the UK

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ABSTRACT

Cultivated meat represents an emerging approach to food production, yet its consumer adoption remains uncertain. Using an experimental mixed design, this study examined the impact of different informational messages on five indicators of cultivated meat acceptance in the UK (trying, wanting, liking, buying and incorporating into diet). A total of 346 participants ($M = 25.6$ years, 65% female) were randomly assigned to one of four conditions: General Information, Social Norms, Environmental Impact, and Combined (integrating social norms and environmental impact). A questionnaire was used to ascertain baseline knowledge and participants' views of cultivated meat before and after viewing three condition-specific posters for 30 s each. Non-parametric analyses were conducted to examine changes across acceptance indicators following message exposure. Social norms messaging significantly increased participants' likelihood of liking ($Z = -2.88$, $p = .004$), buying ($Z = -2.39$, $p = .017$), and incorporating cultivated meat into their diet ($Z = -2.22$, $p = .026$). Environmental impact messaging showed inconsistent effects, while the combined information showed a positive trend only on a few measures of acceptance. The general information condition showed significant decreases in participants' likelihood to try ($Z = -2.43$, $p = .015$) and want ($Z = -2.65$, $p = .008$) cultivated meat. These findings suggest that social norms may play a particularly important role in shaping acceptance of cultivated meat and that strategically emphasising normative cues may be more effective than providing non-targeted or purely environmental information.

## 1. Introduction

Global meat consumption has increased substantially in recent decades, driven by the growth of a global middle class, the cultural centrality of meat in many diets, and the perceptions of meat as essential for health (Almeida et al., 2023; Bryant et al., 2020; Markoni et al., 2023). Although some high-income countries have experienced declines in beef and pork consumption, global meat protein intake is projected to increase by 14% between 2021 and 2030 (OECD/FAO, 2021; OECD, 2023), intensifying environmental and ethical concerns and underscoring the need for alternative protein sources to meet future demand (Parlasca & Qaim, 2022).

Cultivated meat, produced by growing animal muscle cells in bioreactors rather than by raising and slaughtering animals, has emerged as a potential alternative to conventional meat (Bryant & Barnett, 2018; Treich, 2021). It is frequently promoted for its potential to reduce land and water use and to eliminate animal slaughter, appealing to sustainability and animal welfare concerns (Treich, 2021). However, recent analyses indicate that these benefits are not guaranteed. Cultivated meat production is energy-intensive, and its environmental impact depends heavily on the use of renewable energy sources (Tavan et al., 2025). Cultivated meat can therefore be understood as a technological innovation characterised by both promise and uncertainty.

Acceptance of cultivated meat will be shaped not only by perceptions of its environmental or ethical benefits but also by psychological, cultural, and social barriers. Research shows that consumers associate cultivated meat with unnaturalness, artificiality, and potential health risks (Onwezen et al., 2021; Pakseresht et al., 2022; Siegrist & Hartmann, 2020). These concerns are shaped by food neophobia, disgust sensitivity, and the cultural embeddedness of conventional meat (Mancini & Antonioli, 2022; Wendler, 2023). While survey research indicates a willingness to try cultivated meat, sustained dietary adoption remains uncertain (Bryant & Barnett, 2020; Liu et al., 2021; Rombach et al., 2022; Szejda et al., 2021), underscoring the importance of examining the social and psychological contexts in which these evaluations occur.

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Social norms represent a particularly relevant social influence in this context. Eating is a fundamentally social activity, and individuals are strongly influenced by the attitudes and behaviours of others in their social environment (Fernqvist et al., 2024; Higgs, 2015; Robinson et al., 2014). Normative cues communicate which behaviours are common (descriptive norms), socially approved (injunctive norms), or changing over time (dynamic norms) within a reference group (Cialdini et al., 2006; Sparkman & Walton, 2017). Such cues can reduce uncertainty surrounding novel foods by signalling social acceptability and behavioural appropriateness (Onwezen et al., 2021). Norms have been shown to shape openness to various alternative proteins, including insects, algae, plant-based products and cultivated meat (Jensen & Lieberoth, 2018; Onwezen et al., 2021; Zou & Savani, 2019). This aligns with the Theory of Planned Behaviour (Ajzen, 1991), which identifies subjective norms as a key determinant of behavioural intentions, particularly in contexts characterised by limited knowledge or direct experience. Similarly, the Diffusion of Innovations framework (Rogers, 2003) highlights compatibility with prevailing social norms as a critical factor in early adoption, making normative cues especially relevant for emerging food technologies such as cultivated meat.

Experimental and survey research indicate that normative cues can increase openness to alternative proteins, including cultivated meat (Engel et al., 2024; Lewisch & Riefler, 2023). Consumers report greater interest when they perceive peer acceptance or shifting social trends surrounding cultivated meat (Dupont et al., 2022; Motoki et al., 2022). However, experimental evidence remains limited, particularly within the UK. This gap is notable given evidence that UK consumers place strong emphasis on alignment between food choices and prevailing social norms (Apostolidis & McLeay, as cited in Szejda et al., 2020), suggesting that social norms messaging may represent an influential yet under-examined communication strategy.

Environmental impact messaging represents another dominant framing in cultivated meat communication. Several studies suggest that highlighting environmental or sustainability benefits can increase interest in cultivated meat and other alternative proteins (Baum et al., 2021; Palmieri et al., 2020; Verbeke et al., 2015), and environmental concern has been linked to greater openness to cultivated meat (Onwezen et al., 2021). However, other research suggests that such benefits may be insufficient to counteract negative reactions, particularly disgust, among high meat consumers (Pakseresht et al., 2022). Moreover, anticipated sustainability gains may not always materialise under real-world production conditions (Escobar et al., 2021; Risner et al., 2024).

Despite these debates, environmental sustainability remains one of the most prominent rationales for the development and promotion of cultivated meat in both academic and industry discourse, making it a theoretically and practically relevant frame for empirical comparison (Bryant & Barnett, 2018; Fu et al., 2023; Siddiqui et al., 2022). Environmental claims are also relatively abstract and rely on trust in external information rather than direct experience, rendering them particularly sensitive to framing effects and communication strategies. From a Diffusion of Innovations perspective, environmental benefits may reflect perceived relative advantage, although the extent to which consumers prioritise this attribute remains unclear.

The Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1981) proposes that attitude change occurs via two routes: a central route, involving systematic evaluation of information based on facts and arguments, and a peripheral route, which relies on heuristic cues such as social approval or popularity (Liu et al., 2022). When motivation or ability to process information is low, attitudes are more likely to be shaped by peripheral cues, whereas higher motivation supports central-route processing. In the context of cultivated meat, environmental impact information may engage central-route processing through sustainability arguments and factual claims, while social norms may function as peripheral cues by signalling social acceptance.

Combining social norms and environmental messaging may therefore engage multiple psychological processes simultaneously. From an ELM perspective, normative cues may reduce initial uncertainty via peripheral processing, while environmental information may provide substantive justification via central processing. Research on sustainable food communication suggests that single-focus informational appeals often have limited effects on attitudes and behaviour unless supported by additional motivational or contextual cues (Abrahamse, 2020; Vermeir et al., 2020). Empirical reviews of message framing further indicate that multi-component messages that combine non-conflicting elements can be more persuasive than single-focus appeals across behavioural domains (Chen & Wu, 2020; Florence et al., 2022). Together, this work provides a rationale for examining whether combined messaging enhances acceptance of cultivated meat.

Accordingly, the present study addresses three gaps in the literature: the limited experimental research on cultivated meat acceptance in the UK; the under-examination of social norms as a driver of attitudes toward cultivated meat; and the lack of direct comparisons between different informational messaging strategies, including their potential combined effects. An experimental approach is particularly appropriate in this context, as it enables stronger causal inference regarding the impact of informational messages on acceptance, which is important for emerging food technologies where attitudes are still forming and may be sensitive to framing effects.

This study, therefore, examined the impact of different informational messages on anticipated acceptance of cultivated meat among meat-consuming adults in the UK. The objectives were to: (i) compare the effects of social norms, environmental impact, and combined messaging relative to general information; and (ii) assess whether combined messaging was associated with greater acceptance outcomes relative to single-message conditions. It was hypothesised that social norms and environmental messaging would each increase acceptance relative to general information, and that combined messaging would be associated with higher levels of acceptance compared to other conditions. By testing these hypotheses, the study contributes to understanding how different communication strategies shape consumer openness to cultivated meat and informs research on novel food acceptance and early adoption processes.

In this study, acceptance of cultivated meat is operationalised using multiple intention-based indicators rather than a single composite outcome. Previous research commonly assesses acceptance through measures such as willingness to try, buy, consume regularly, or replace conventional meat (Bryant et al., 2020; Szejda et al., 2021; Wilks & Phillips, 2017). Although these indicators are typically intercorrelated and reflect a common underlying acceptance disposition, evidence suggests they represent conceptually and behaviourally distinct aspects of acceptance that may respond differently to the same intervention (Bryant & Dillard, 2019; Mancini & Antonioli, 2022). Analysing these measures separately allows for a more granular understanding of how different messaging strategies influence specific points along the acceptance continuum, from initial trial intentions to longer-term adoption behaviours such as regular purchasing and dietary incorporation. This approach is particularly important for emerging food technologies, where psychological barriers to trial, regular consumption, and financial commitment may differ and require tailored communication strategies.

## 2. Methodology

### 2.1. Design

The study followed a mixed design, with condition (general information, social norms, environmental impact, combined) as the between-participants factor and time (pre vs. post) as the within-participant factor. Participants were randomly assigned to view one of four sets of informational posters, each designed to emphasise a specific type of messaging. Only the textual content varied to reflect the messaging

strategy. Participants reported their acceptance of cultivated meat (likelihood to try, want, like, buy, and incorporate into the diet) before and after viewing the informational messages, allowing changes in acceptance to be assessed over time.

This study was approved by the Liverpool Hope University Ethics Board (Ref: SEL-07092023-001) and funded by the School of Psychology at Liverpool Hope University. It was preregistered on the Open Science Framework (osf.io/8zbv7).

### 2.2. Participants

Of the 404 individuals who initially accessed the study, 49 were excluded due to incomplete responses, and nine were removed due to failed attention checks, resulting in a final sample of 346 participants ($M_{age} = 25.6$, $SD = 10.6$; 65% female). Participants were eligible if they were at least 18 years old and consumed meat. Recruitment was carried out through a combination of channels: the university's SONA research participation system, the online platform Prolific (restricted to UK-based participants), and public posts on social media (LinkedIn, Instagram, and X). Eighty-four participants were recruited via Prolific, with the remaining participants recruited through the university SONA system and public channels. SONA participants received course credit, while Prolific participants were compensated at an hourly rate of £10 (pro-rated). All participants were offered entry into a prize draw for Amazon vouchers. These data were gathered between October 2023 and April 2024. A power analysis conducted using G*Power version 3.1.9.6. indicated that 280 participants would be sufficient to detect a small effect ($f = 0.10$) in a mixed-design ANOVA with 80% power; the final sample exceeded this requirement. This sample size accounts for the repeated-measures design, which increases statistical sensitivity by reducing error variance compared to purely between-participants designs (Brauer, 2018). In practice, a larger sample was collected to ensure data quality and account for exclusions.

### 2.3. Measures & materials

Baseline familiarity with cultivated meat was assessed using a single item ("How would you rate your knowledge of cultivated meat?") rated on a 10-point Likert scale (1 = *No knowledge at all*, 10 = *Highly knowledgeable*). Participants were provided with a brief description of cultivated meat to ensure they all had a basic understanding of the novel product (see Supplementary Text S1).

Acceptance of cultivated meat (primary outcome) was assessed using five items measuring participants' likelihood to try, want, like, buy, and incorporate cultivated meat into their diet, each rated on a 10-point Likert scale (1 = *Not likely at all*, 10 = *Very likely*). Items were adapted from previous research (Bryant et al., 2020) and showed internal consistency (Cronbach's α = 0.96), with inter-item correlations ranging from $r = .74$ to .93.

Participants reported how much they would be willing to pay for cultivated meat compared to conventional meat (adapted from Wilks & Phillips, 2017). This was measured using two slider items (similar to a visual analogue scale) where the participants indicated how much they would be willing to pay for a daily serving of traditional beef and cultivated beef (range: £1 to £10+). Responses were used to calculate price sensitivity towards cultivated meat.

Two single-item measures assessed perceived disgust ("Cultivated meat is too disgusting for me to eat") and unnaturalness ("Cultivated meat seems unnatural"), adapted from Rosenfeld & Tomiyama, 2022, each rated on a 10-point Likert scale.

Participants reported demographic information (age, gender, ethnicity, education level, and living arrangement) and answered questions about dietary habits and beliefs about meat (adapted from Bryant et al., 2020; Cornelissen & Piqueras-Fiszman, 2022; Wilks & Phillips, 2017). Items were slightly modified by simplifying response options, standardising scales, and using the term 'cultivated meat' for consistency. Measures included frequency of meat consumption in a typical week (from "I don't eat it every week" to "Multiple times a day"), types of meat consumed (chicken, beef, pork, fish, other), beliefs about whether meat is essential for a healthy diet (yes/no), and perceptions of safety regarding conventional and cultivated meat (yes, no, unsure).

Poster engagement was assessed using three items (ease of understanding, effectiveness of message delivery, and influence on views), each rated on a 10-point Likert scale. These engagement items were used for engagement and internal checks but were not included as outcome variables in the main analyses.

All posters were created using Canva and maintained a consistent visual design across conditions. The general information condition presented factual content about cultivated meat's history and development, adapted from the Good Food Institute website (GFI, 2024). The social norms condition presented dynamic, fictional yet plausible statements indicating growing public acceptance of cultivated meat in the UK and included references to fictional sources for credibility. To ensure message plausibility for a novel food product, the social norm materials included limited sensory and evaluative information. As a result, the manipulation does not represent a purely isolated social norms cue, reflecting how normative information is typically embedded within broader real-world food communication. The environmental impact condition focused on benefits such as reduced land use, water consumption, and greenhouse gas emissions, featuring information adapted from different sections of the Good Food Institute website (Swartz, & TheGood Food Institute, 2021, March 9). The combined condition integrated both social and environmental messaging within each poster. Each participant viewed three posters within their assigned condition (see Versions 1, 2, and 3 for each condition in Panel 1).

These posters were piloted with a sample of eight individuals to ensure the posters were clear, credible, and engaging, and their feedback led to minor adjustments to text phrasing and layout. This process helped enhance the validity of the experimental stimuli.

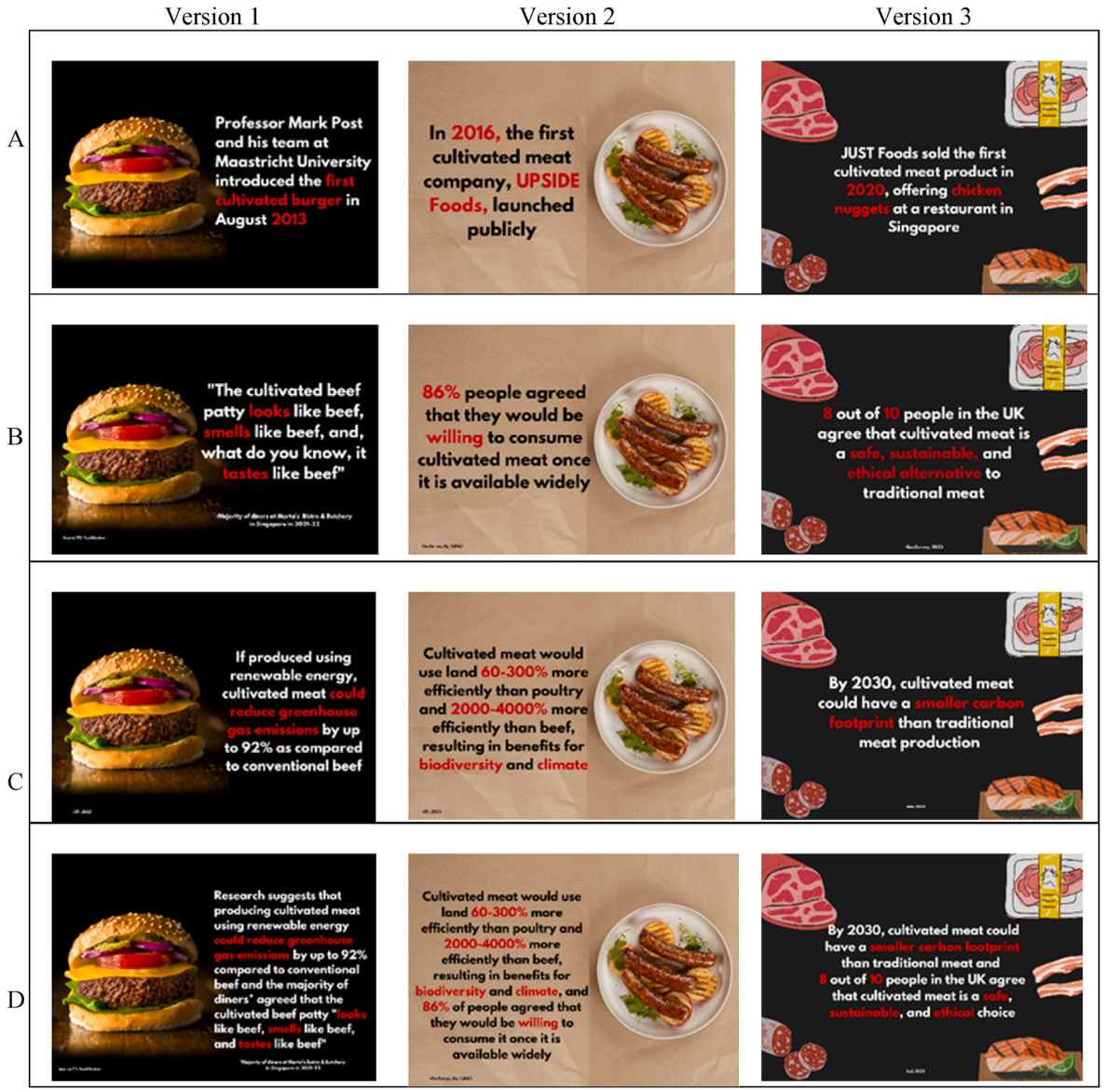
### 2.4. Procedure

The study was conducted online using the Qualtrics survey platform (Qualtrics, Provo, UT) and took approximately 15 min to complete. Participants completed questions about dietary preferences and informational posters attributed to *Stakes on Steak*, a fictitious initiative promoting sustainable eating practices. After providing informed consent, participants completed baseline measures related to cultivated meat.

Participants were then randomly assigned by the survey platform to one of four messaging conditions. They viewed three posters corresponding to their assigned condition, each displayed for a minimum of 30 s before participants were permitted to proceed. This time restriction was implemented to ensure adequate exposure to the materials.

Following the poster exposure, participants completed demographic information questions and items related to their dietary practices. Within this section, participants also completed post-exposure measures related to cultivated meat acceptance. These items were embedded alongside the demographic and dietary questions so that the purpose of the posters and the subsequent attitude measures would not be immediately apparent.

At the end of the study, participants completed an open-ended item asking what they thought the study was about to check for potential demand characteristics. They were also asked about the plausibility of the poster messages and whether these appeared to influence their views. Finally, participants were debriefed regarding the true purpose of the study and the four poster information conditions and were given the opportunity to enter a prize draw for Amazon vouchers via a separate link to maintain anonymity.




**Panel 1.** Informational posters used in the study: (A) General information condition, (B) Social norms condition, (C) Environmental impact condition, (D) Combined condition.

### 2.5. Analysis strategy

Participants ($n = 58$) who failed attention checks or left large sections of the survey incomplete were excluded from all analyses. Data were screened for quality, including checks for duplicate entries, implausible or inconsistent responses (for instance, straight-lining across items), and excessive missing data.

All data were analysed using SPSS 29. While a mixed ANOVA was initially planned during the pre-registration stage, the distribution of primary outcome variables violated assumptions of normality. Therefore, changes in acceptance from pre-to post-message exposure were examined within each condition using Wilcoxon Signed-Rank Tests. Mann-Whitney U tests were used to compare differences based on age group, and Kruskal-Wallis tests examined differences in acceptance scores across groups based on meat consumption frequency. Spearman's rank-order correlations were used to examine associations between baseline knowledge and cultivated meat acceptance. Cronbach's alpha was calculated to assess internal consistency for the five-item acceptance measure. Alpha was set at the conventional $p \leq .05$.

## 3. Results

### 3.1. Descriptive statistics

The sample ($N = 346$) was predominantly female (65%) and White (83%), with ages ranging from 18 to 68 years. Of the sample, 60% were aged between 18 and 21 years ($M = 25.6$, $SD = 10.6$). Nearly 70% of participants consumed meat either three to four times a week or almost every day, and 12% reported consuming meat multiple times a day. Chicken (97%) and beef (81%) were the most consumed types.

Prior familiarity with cultivated meat was generally low, while perceptions of unnaturalness were moderately high and disgust ratings fell slightly below the scale midpoint. Detailed descriptive statistics and baseline comparisons across conditions are presented in Table 1.

### 3.2. Baseline checks

Mann-Whitney U tests showed no significant differences in baseline acceptance outcomes between participants recruited via Prolific and those recruited through other channels across the five outcome variables

**Table 1**
Participant characteristics and baseline measures by condition.

| Variable | General Information (n = 89) | Social Norms (n = 84) | Environmental Impact (n = 85) | Combined (n = 88) | Total (N = 346) | Test (p) |
|---|---|---|---|---|---|---|
| Age (years) | 25.4 (10.6) | 26.0 (11.6) | 25.9 (11.2) | 25.0 (9.0) | 25.6 (10.6) | $F$ (3, 342) = 0.15, $p$ = .93 |
| Knowledge of Cultivated Meat | 3.9 (1.9) | 4.0 (1.9) | 3.5 (2.0) | 3.2 (1.9) | 3.6 (1.9) | $F$ (3, 342) = 3.29, $p$ = .02 |
| Perceived Unnaturalness | 6.4 (2.7) | 6.5 (2.6) | 7.1 (2.5) | 6.6 (2.8) | 6.7 (2.7) | $F$ (3, 342) = 1.15, $p$ = .33 |
| Disgust | 4.4 (2.7) | 4.2 (2.5) | 5.0 (2.7) | 4.5 (3.0) | 4.5 (2.7) | $F$ (3, 342) = 1.27, $p$ = .28 |

(all $p$ values > .05). To examine whether baseline acceptance differed by age, participants were categorised into two groups: those aged under 25 years ($n$ = 240) and those aged 25 years or older ($n$ = 106). Mann-Whitney U tests revealed no statistically significant differences between the two age groups across any of the baseline acceptance measures (all $p$ values > .05).

### 3.3. Within-condition changes

To examine the effect of each messaging condition, pre- and post-exposure scores were compared within each group using Wilcoxon signed-rank tests. Changes across the five acceptance items (try, want, like, buy, incorporate) were analysed separately for each condition.

In the general information condition, there was a significant decline in participants' likelihood to try ($Z$ = −2.43, $p$ = .02, $r$ = −.26), and want cultivated meat ($Z$ = −2.65, $p$ = .01, $r$ = −.28). No significant changes were observed for liking, buying, or incorporating cultivated meat.

In the social norms condition, there were significant increases in the likelihood to like ($Z$ = −2.88, $p$ = .004, $r$ = −.31), buy ($Z$ = −2.39, $p$ = .02, $r$ = −.26), and incorporate ($Z$ = −2.22, $p$ = .03, $r$ = −.24), all with small-to-medium effect sizes. The changes in likelihood of wanting were in the positive direction but did not reach statistical significance.

In the environmental condition, the only significant change observed was a decline in the likelihood of wanting cultivated meat ($Z$ = −3.41, $p$ < .001, $r$ = −.37). No significant changes were observed for the likelihood of trying, liking, buying, or incorporating cultivated meat.

The combined condition, which presented both social norms and environmental impact messages, resulted in a significant increase in participants' willingness to incorporate cultivated meat into their diet ($Z$ = −2.35, $p$ = .02, $r$ = −.25). No other outcome variables in this condition showed significant changes from pre-to post-exposure, although the direction of change was generally positive across all measures.

Figs. 1–5 illustrate the changes in the mean scores by condition across the five measures constituting acceptance of cultivated meat.

**Likelihood to Try**.
**Likelihood to Want**.
**Likelihood to Like**.
**Likelihood of Buying**.
**Likelihood of Incorporating into the diet**.
**Willingness to Pay**.

Participants reported being willing to pay approximately 20% less for cultivated beef compared to what they currently pay for conventional beef. Willingness to pay for cultivated meat relative to conventional meat was positively associated with all post-exposure acceptance indicators (ρ = .38-.49, all $p$ < .001). Only 14% of the sample indicated they would be willing to pay more for cultivated meat, while 55% expressed a preference for paying less. Based on responses to the pricing sliders, participants' mean willingness to pay for traditional beef was £4.83 ($SD$ = 1.9), whereas their mean willingness to pay for cultivated beef was £3.89 ($SD$ = 2.0).

### 3.4. Meat consumption behaviour

To determine whether habitual meat intake influenced acceptance,

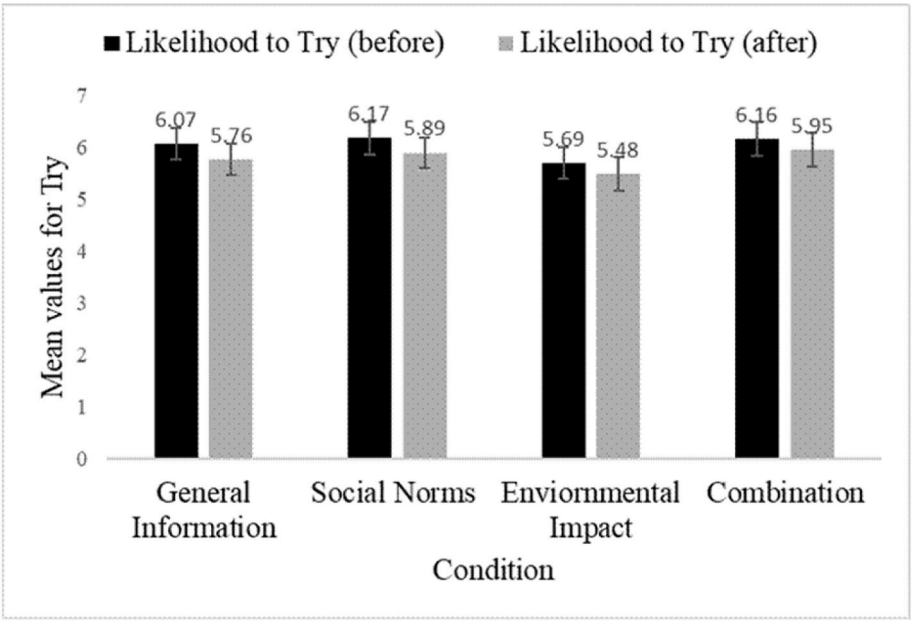



**Fig. 1.** Changes in the likelihood to try cultivated meat pre-vs post-message exposure.

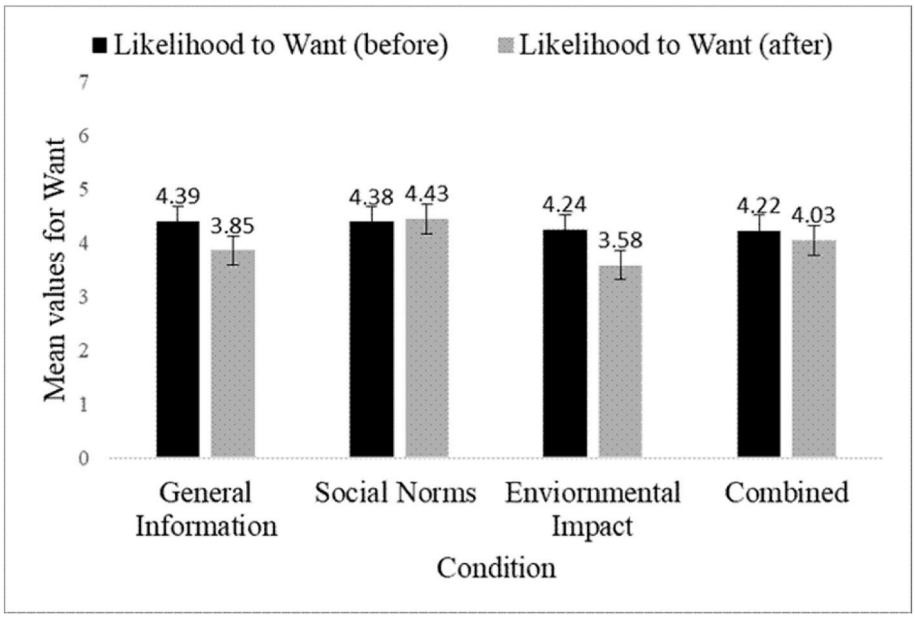



**Fig. 2.** Changes in the likelihood to want cultivated meat pre-vs post-message exposure.

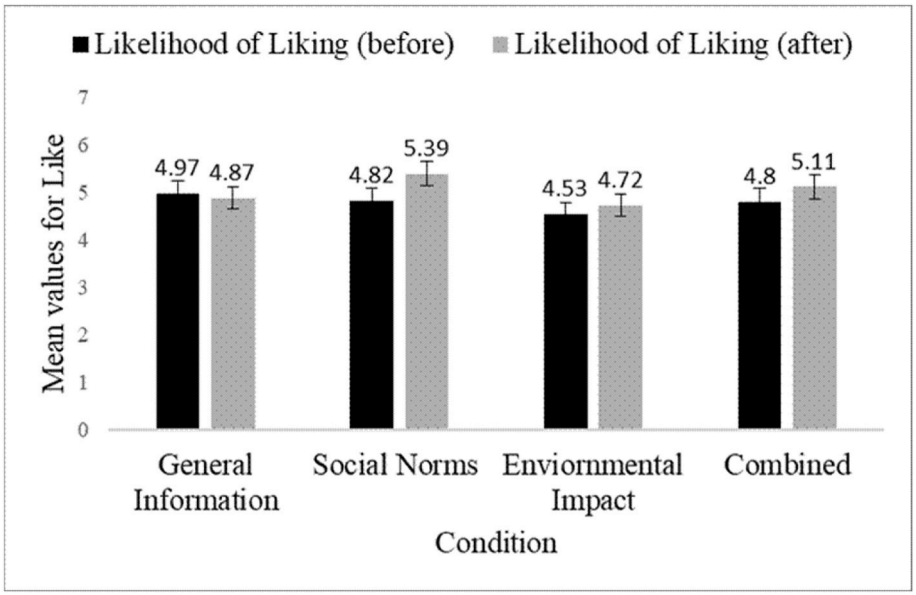



**Fig. 3.** Changes in the likelihood to like cultivated meat pre-versus post-message exposure.

Kruskal-Wallis tests were conducted to compare participants grouped by self-reported meat consumption frequency (rarely, occasionally, frequently, multiple times per day). No significant differences were observed across groups on any of the five acceptance items (all p values $\leq .92$), indicating that meat consumption frequency was not associated with acceptance outcomes.

Regarding perceptions of meat consumption and its safety, 75% of participants believed that eating meat is essential for a healthy diet. When asked about the safety of the meat they currently consume, 89% considered it to be safe, while 11% believed it was unsafe. In contrast, views on cultivated meat were more divided: 62% of participants perceived it as a safe food product, 22% considered it unsafe, and 16% were unsure. Participants were also asked whether they had ever considered replacing conventional meat with alternative options. Just over half (54%) reported that they had never considered doing so, while 46% indicated they had. A weak but significant positive correlation was found between meat consumption frequency and consideration of alternatives ($r_s = 0.21$, $p < .001$), suggesting that individuals who consume meat more frequently may also be more open to exploring meat alternatives.

### 3.5. Other analyses

Spearman's correlations showed significant positive associations between baseline knowledge of cultivated meat and all five acceptance measures (all $p$ values $< .001$; see Supplementary Table S1).

When participants were asked at the end of the study to describe in their own words what they believed the purpose of the study was, the most common interpretations included assessing public perceptions of cultivated meat, measuring willingness to try it, and providing information or education about the product. About 8% of the participants correctly guessed that the purpose was related to examining the impact

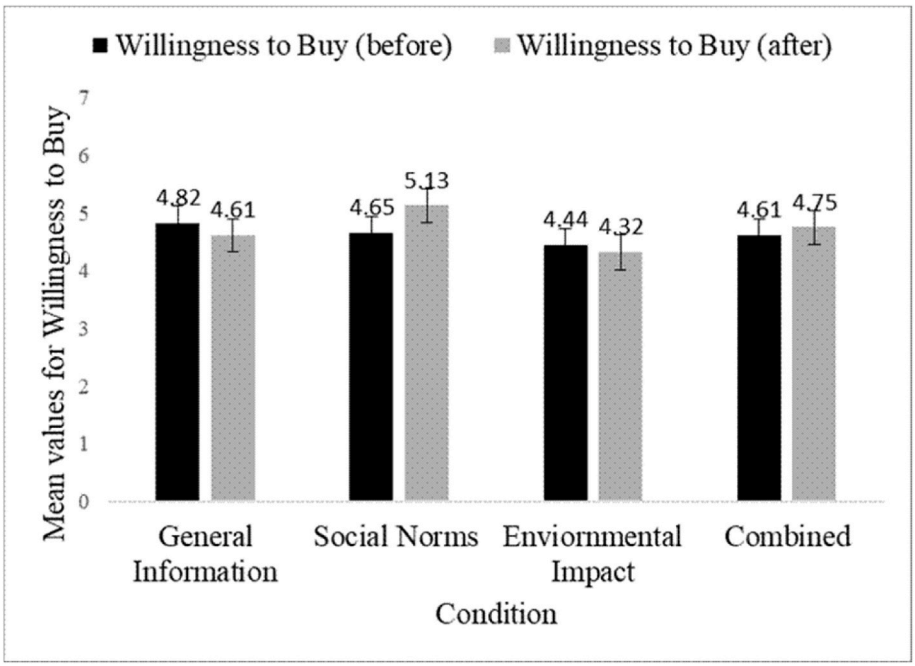



**Fig. 4.** Changes in the likelihood to buy cultivated meat pre-vs post-message exposure.

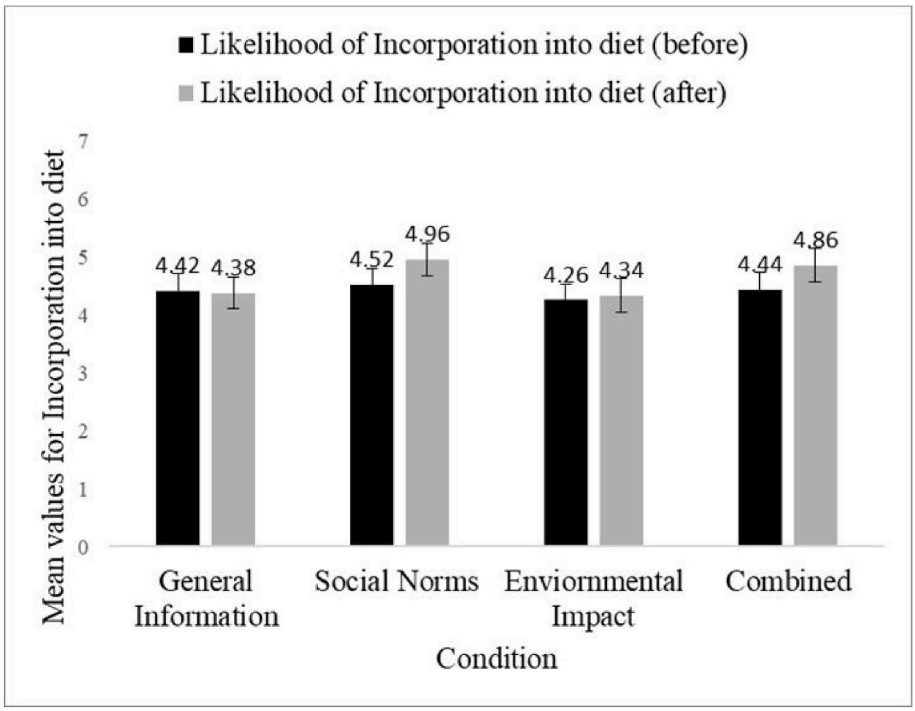



**Fig. 5.** Changes in the likelihood of incorporating cultivated meat into the diet pre-vs post-message exposure.

of the posters on their attitudes before and after exposure to information.

When participants were asked whether the poster messages had influenced their views, 50% reported being 'slightly' influenced by the posters. In the general information condition, the majority (56%) indicated that the messages did not influence their views. In contrast, the most common response across the three experimental conditions was 'slightly influenced': 48% in the social norms condition, 58% in the environmental impact condition, and 56% in the combined condition.

Regardless of condition, most participants found the poster content credible. A total of 87% of participants across all groups judged the poster messages to be plausible. This included 88% in the social norms condition, 87% in the environmental condition, and 91% in the combined condition.

## 4. Discussion

### *4.1. Summary of findings*

This study examined how different types of informational messaging,

including social norms, environmental impact, and a combination of both, influence the anticipated acceptance of cultivated meat among meat-consuming adults in the UK. The findings offer several key insights. Messages emphasising social acceptance were associated with consistent positive changes in participants' reported likelihood of liking cultivated meat, as well as their willingness to buy and incorporate it into their diet once available in the UK. In contrast, environmental impact messaging did not increase acceptance and, in one case, was associated with a decline in participants' likelihood to want cultivated meat. The combined condition showed some benefits, particularly for dietary incorporation, but did not outperform the social norms condition. These findings provide experimental evidence that social norm-based messages can meaningfully shape consumer responses to cultivated meat, relative to factual environmental appeals in this experimental context.

The general information condition, which offered factual information about cultivated meat's history and development, resulted in small but significant declines in the likelihood to try, want, and buy it. This suggests that factual information alone may not improve perceptions when no motivational framing is provided. However, it is noteworthy that post-exposure acceptance levels in the general information condition were comparable to, and in some cases higher than, those observed in the environmental impact condition, indicating that general information was not uniformly less effective across message types.

The social norms condition was associated with consistent positive changes across several indicators of cultivated meat acceptance, reinforcing existing evidence that perceived peer behaviour plays a central role in shaping food-related decisions (Higgs, 2015; Robinson et al., 2014; Sparkman & Walton, 2017). Participants exposed to messages framing cultivated meat as socially accepted reported higher likelihoods of liking, buying, and incorporating it into their diet, suggesting that highlighting changing social trends can foster openness toward novel foods, particularly in contexts where personal experience and product familiarity remain limited (Engel et al., 2024; Lewisch & Riefler, 2023). These findings are consistent with the Theory of Planned Behaviour (Ajzen, 1991), which emphasises perceived social approval as a key determinant of behavioural intentions, and with the Diffusion of Innovations framework (Rogers, 2003), which underscores the importance of social influence and early adopters in the uptake of emerging technologies. Notably, the social norms condition in this study also incorporated sensory and experiential information, and the observed effects should therefore be interpreted as reflecting the combined influence of normative framing and experiential cues rather than social norms in isolation. Despite the overall positive pattern, no significant effects were observed for participants' likelihood to try or want cultivated meat in the short term, indicating a potential distinction between longer-term behavioural intentions and immediate action-oriented intentions. One plausible explanation is the current lack of product availability, which may constrain the extent to which social norms translate into short-term behavioural readiness. Taste remains a dominant factor in food choice (Ruzgys & Pickering, 2020), and without opportunities to sample cultivated meat or observe others consuming it, social norms may be less effective in shaping immediate behavioural intentions.

The environmental messaging condition showed limited effects on cultivated meat acceptance. Despite environmental benefits being widely cited as a key rationale for cultivated meat adoption (Baum et al., 2021; Palmieri et al., 2020; Verbeke et al., 2015), exposure to environmental information alone did not lead to more positive behavioural intentions in the present study. One possible explanation is that such messaging may have been interpreted as highlighting cultivated meat as unnatural or artificial, thereby eliciting psychological resistance (Siegrist & Hartmann, 2020). This interpretation aligns with the *natural-is-better* heuristic, whereby consumers tend to perceive natural products as inherently safer or more acceptable (Meier et al., 2019). More broadly, the findings suggest that environmental arguments may be insufficient to override more immediate psychological concerns, such as food safety and perceived naturalness, which have been shown to play a central role in shaping responses to novel food technologies (Siegrist & Hartmann, 2020; Wilks et al., 2024). In addition, environmental information may require more effortful cognitive processing and personal engagement to be persuasive, and participants may have been less motivated or confident in engaging with such abstract benefits. Relative to the more heuristic influence of social norm cues, environmental messaging may therefore require more insightful or personally relevant framing to resonate effectively with consumers.

In the combined social norms and environmental impact condition, participants reported a greater willingness to incorporate cultivated meat into their diets, suggesting some potential for interaction between message elements when multiple persuasive cues are presented together. However, this effect was not consistently observed across other acceptance outcomes, and the combined condition did not produce stronger acceptance outcomes than the social norms condition alone. This pattern indicates that simply merging multiple persuasive appeals may not be sufficient to enhance acceptance and may, in some cases, dilute the effectiveness of particularly strong message components. Although prior message-framing research suggests that combining compatible message elements can increase persuasive impact under certain conditions (Chen & Wu, 2020; Florence et al., 2022), more recent evidence indicates that message effectiveness depends on the specific alignment and relevance of combined content rather than the accumulation of multiple appeals (Lin et al., 2024). In the present study, the inclusion of environmental impact information alongside social norms may therefore not have added incremental value beyond normative framing alone, potentially due to cognitive overload or variability in perceived relevance across message elements. Taken together, these findings suggest that the effectiveness of combined messaging is highly context-dependent and that the optimisation of message combinations and delivery remains an important avenue for future research. In particular, future work could examine whether sequential presentation of different message types enhances clarity and persuasive impact compared to their simultaneous presentation.

Participants' self-reported knowledge of cultivated meat was relatively low, and greater baseline knowledge was positively associated with acceptance across all measures. This aligns with previous research suggesting that familiarity with novel food technologies is linked to greater openness and reduced resistance. Participants also demonstrated clear price sensitivity: most preferred to pay less for cultivated meat than for conventional meat, although a minority indicated willingness to pay the same price. Together, these findings provide useful context for interpreting messaging effects, indicating that informational strategies may operate against a backdrop of low familiarity and cost sensitivity.

A weak positive association was observed between meat consumption frequency and consideration of alternative meat products. While this suggests that frequent meat-eaters may be slightly more open to alternatives such as cultivated meat, consumption frequency alone does not appear to be a strong predictor of acceptance. This reinforces the importance of psychological and social factors, rather than dietary habits alone, in shaping responses to cultivated meat.

While most participants perceived conventional meat as safe, views on cultivated meat were more divided. This pattern likely reflects broader scepticism toward novel food technologies (Verbeke, 2015) and highlights trust as a relevant contextual factor in cultivated meat acceptance.

### 4.2. Practical implications

From a practical standpoint, these findings suggest that public communication efforts around cultivated meat may benefit from messages emphasising social acceptance and perceived uptake. For stakeholders such as producers, marketers, and policymakers, messages that emphasise growing acceptance, shifting behaviours, and peer endorsement may be more effective in reducing hesitancy than sustainability

arguments and statistics alone. Communications could include testimonials, references to changing dietary trends, or visual imagery depicting social settings where cultivated meat is being enjoyed.

Environmental messaging should not be dismissed but may need to be reframed to emphasise personal or familiar benefits, such as health or local environmental impact. Rather than abstract appeals to emissions or global impact, linking environmental benefits to everyday behaviours, health co-benefits, or local relevance may better engage consumers. This tailoring could help overcome psychological distance and make abstract issues like climate change feel more immediate and actionable. Further research is needed to explore these points.

Finally, findings on willingness to pay underscore that positive attitudes alone are not enough to ensure adoption. Most participants preferred to pay less for cultivated meat than for conventional meat, indicating that price sensitivity remains a barrier. Successful commercialisation will likely depend not only on social validation but also on competitive pricing and clear, relatable value propositions. Communication strategies should therefore avoid overemphasising premium or futuristic framing and instead highlight familiarity, affordability, and everyday use.

### 4.3. Limitations and future research

This study offers valuable insights, but several considerations should guide its interpretation and future research. The sample was predominantly young and female, reflecting recruitment through university channels and therefore included a substantial proportion of students. This recruitment strategy was adopted to access a population likely to be familiar with emerging food technologies and open to considering novel food products, aligning with the study's focus on early-stage acceptance. While this limits generalisability to the broader UK population, particularly older adults and family households, it represents a theoretically relevant group, as younger consumers are often early adopters of food innovations and are likely to be among the first to try cultivated meat products as they enter the market (Szejda et al., 2021). However, food choices among students may differ from those made in more stable household contexts, as students' eating practices are often shaped by convenience, individual decision-making, and greater price sensitivity compared to routine family meals (Almoraie et al., 2024; Li et al., 2022). These contextual factors may influence how informational messages are processed and how acceptance is expressed. Future research should therefore examine more diverse age groups and household settings to assess whether similar patterns emerge across different consumption contexts and financial constraints.

Although the experimental conditions were designed to emphasise distinct informational frames, the messages necessarily included multiple supportive cues. For example, the general information condition incorporated historical and institutional references that may have influenced perceived credibility, while the social norms and combined conditions included limited sensory or evaluative information alongside their primary framing. As a result, the conditions do not represent entirely isolated manipulations of single attributes. While the conditions differed systematically in their dominant framing emphasis, future research could further disentangle the effects of specific message components using more tightly controlled or factorial designs.

As with much attitudinal research, the study relied on self-reported intentions. Future studies could extend this work by incorporating behavioural measures, such as taste sessions or product trials, to examine how reported intentions translate into action.

The environmental impact message may have felt generic, and more locally tailored framings may resonate more strongly (e.g., highlighting local ecosystem benefits rather than broad land-use reduction). Future research could address this through larger pilot testing to refine messages or through co-production with stakeholders and participants, ensuring clarity, resonance, and contextual relevance.

Finally, the study did not measure individual differences that may moderate responses to messaging, such as food neophobia, disgust sensitivity, or trust in food technology. Incorporating such measures would help identify which messaging strategies are most effective for different consumer profiles.

## 5. Conclusion

This study highlights the psychological and social factors that shape public responses to cultivated meat, with a focus on how different types of informational messaging influence its anticipated acceptance. The findings suggest that messages incorporating social norm cues, alongside other supportive information, may help reduce perceived unfamiliarity and increase openness to some extent, whereas environmental impact messages may require careful framing to resonate meaningfully with audiences. Rather than advocating for cultivated meat, this research seeks to understand how individuals interpret and respond to communication about novel food technologies. As cultivated meat moves closer to commercial availability, understanding these patterns of response will be important for anticipating consumer attitudes and identifying potential barriers to acceptance. The present findings provide a foundation for future research and may inform how policymakers, communicators, and researchers approach public engagement around emerging food innovations.

## CRediT authorship contribution statement

**Harmehak Singh:** Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation. **Gregory S. Keenan:** Writing – review & editing, Visualization, Validation, Methodology, Formal analysis, Conceptualization. **Lisa Di Lemma:** Writing – review & editing, Supervision. **Rosanna Cousins:** Writing – review & editing, Supervision, Methodology.

## Preregistration

This study was preregistered on the Open Science Framework (https://osf.io/8zbv7).

## Ethics statement

This study was approved by the Liverpool Hope University Ethics Board (Ref: SEL-07092023-001). All participants provided informed consent prior to participation.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2026.108552.

## Data availability

The data that support the findings of this study are available from the corresponding author upon request.

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