

Consumer Attitudes Toward Conventional, Regenerative, Plant-Based, and Cell-Cultured Meat: The Role of Meat Attachment and Food Technology Neophobia

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Supplementary Materials: Code, Data, Materials, Preregistration [see [Index of Supplementary Materials](#)]



Abstract

This study explored consumer perceptions of meat and alternative proteins, testing a conceptual framework initially developed to describe the perspectives of highly engaged stakeholders. We classified 600 participants from the USA and UK, split evenly between omnivores, vegetarians, and vegans, into one of four clusters based on meat attachment and food technology neophobia—groups we termed eco-modernists, high-tech vegans, good foodies, and carnivore traditionalists. Meat attachment was positively associated with attitudes toward conventional and regenerative meat and negatively associated with attitudes toward plant-based meat and whole food veggie burger products. Food technology neophobia was negatively associated with attitudes toward both cultured meat and plant-based meat. At a time when there is widespread discussion about the merits and drawbacks of diverse forms of meat production (conventional and regenerative), alternative protein development (plant-based and cell-cultured), and voluntary dietary change, the results offer insights for both scholars and practitioners with respect to consumer perceptions and purchasing intentions.

Keywords

attitudes, cultured meat, food technology, regenerative meat, plant-based, vegetarian



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Non-Technical Summary

Background

There is wide-ranging debate regarding the optimal future of meat, as a host of food system advocates—including scientists, researchers, farmers, business leaders, activists, and policy-makers—offer different visions of the best path forward. An important area of disagreement focuses on the role of “alternative proteins”, including plant-based or cell-cultured products that aim to substitute for conventional animal foods. Previously, Broad (2023) proposed a framework to outline this landscape, arguing that advocates’ positions in these debates coalesced around their attitudes toward novel food technologies and the strength of their meat attachment.

Why was this study done?

Broad’s framework was developed to understand the positions of highly committed food system advocates, but it had not been empirically validated or applied to everyday consumers. Furthermore, research had not explicitly investigated how people’s attachment to meat and attitudes toward novel food technologies predicted their evaluations of, and willingness to try, different protein products.

What did the researchers do and find?

We conducted an online study with vegan, vegetarian, and omnivore participants from the UK and USA. Participants completed measures of meat attachment (MA; how much they enjoy, depend on, are emotionally connected to, and feel entitled to eat meat) and food technology neophobia (FTN; how skeptical vs enthusiastic they are about new food technologies). They also rated their perceptions of and their willingness to try a range of five protein products (whole-food veggie burgers, conventional meat, plant-based meat, cultured meat, and regenerative meat).

Most participants were classified into one of four different groups: High-Tech Vegans (low FTN, low MA), Eco-Modernists (low FTN, high MA), Good Foodies (high FTN, low MA), and Carnivore Traditionalists (high FTN, high MA). Roughly 1/3 of participants did not fit into a group because they had scores near the mean on one of the two variables.

MA positively predicted attitudes toward conventional meat and regenerative meat, and negatively predicted attitudes toward whole-food veggie burgers and plant-based meat. It did not significantly predict attitudes toward cultured meat. FTN negatively predicted attitudes toward cultured meat and plant-based meat. It did not significantly predict attitudes toward any of the other protein products.

What do these findings mean?

This study found that consumers’ attitudes toward protein foods appear more related to how attached they are to eating meat than how they feel about the technologies used to make them. The main exception is cultured meat, where attitudes toward food technology appear more important. The power of meat attachment demonstrated in these findings

offers sobering implications for anyone invested in efforts to reduce meat consumption on account of environmental, ethical, or public health considerations. Future research could build on this work by examining these dynamics in other cultural contexts, especially those where views about meat and food technology differ from those in the US and UK.

Debates about the future of meat are shaped by a mix of empirical and value-driven assumptions about what constitutes a healthy, ethical, and sustainable food system (Godfray et al., 2018). In recent years, a range of food system advocates—including scientists, researchers, farmers, business leaders, activists, and policymakers—have proffered different visions of the best path forward, highlighted by divergent attitudes toward “alternative proteins” that aim to replace animal products with plant-based or cell-cultured substitutes (Martin & Katz-Rosene, 2020). Drawing on a thematic analysis of stakeholder discourse, Broad (2023) proposed that positions in the “fake meat debates” coalesced around two core ideological constructs—1) meat attachment and 2) socio-technical imaginaries. Meat attachment refers to the extent to which a person is strongly bonded to the importance of animal-derived meat as food; the concept of socio-technical imaginaries refers to how individuals and groups conceptualize the ideal relationships between technology and society. From there, Broad (2023) outlined a matrix of four ideal-type advocacy positions, as he termed it: 1) *ecomodernists* (high meat attachment with a techno-optimistic imaginary), 2) *carnivore traditionalists* (high meat attachment with a techno-skeptical imaginary), 3) *high-tech vegans* (low meat attachment with a techno-optimistic imaginary), and 4) *good foodies* (low meat attachment with a techno-skeptical imaginary).

The central aim of this paper is to assess the extent to which the core dimensions outlined by Broad (2023) relate to consumer perceptions of different types of meat and alternative protein products—namely conventional meat (produced through large-scale industrialized animal food production), regenerative meat (produced through small-scale traditional animal husbandry), whole-food veggie burgers (composed of minimally processed plant-based ingredients), plant-based meat alternatives (produced by combining plant-based ingredients with food and flavor science to mimic conventional meat), and cell-cultured meat (also known as cultivated or lab-grown, which uses biotechnology and tissue engineering to create animal products without animal slaughter).

Broad’s (2023) framework is one of several that have been developed to describe ideological distinctions between highly-committed meat and alternative protein stakeholders (see also Garnett, 2015; Martin & Katz-Rosene, 2020). To date, however, consumer-focused research has not explicitly investigated how one’s ideological commitment to meat and orientation toward technological change shape perceptions and purchasing intentions. At a time when debates about meat and alternative proteins have received significant attention in the public sphere (Tziva et al., 2023), it is important to explore the

similarities and differences at these two levels of analysis. While we might expect food system advocates to be more ideologically driven than the general public, consumer food choices are still influenced by a range of cultural narratives and values, including those specifically related to meat and technology (Lusk & Briggeman, 2009). Evidence that consumer perceptions align with those of advocates would suggest that these ideological constructs shape not only expert discourse but also broader public opinion. If consumer perceptions do not align with the framework, however, that would indicate that advocate-driven public debates do not necessarily reflect how consumers consider the topic of meat and alternative proteins in their everyday lives. These findings could have scholarly implications in the study of human-animal relations, as well as practical implications for those engaged in strategic communication to promote plant-based dietary change.

In recent years, critical scholarship on the meat and alternative protein debates has largely focused on describing how diverse advocates frame their positions and advance distinct policy proposals (Amato et al., 2023; Garnett, 2015; Sexton et al., 2019). Specifically, some advocates have called for the “sustainable intensification” of large-scale animal food production, aimed at harnessing the power of technological innovation to meet rising global demand while minimizing environmental impacts and animal welfare concerns (Godfray, 2015; Lusk & Norwood, 2011). Others have advanced a vision of small-scale, localized, and “regenerative” animal food production, grounded in an ethos of “naturalization” that touts traditional agricultural practices as humane and sustainable (Cusworth et al., 2022; McGregor & Houston, 2018). Some have put forth arguments focused on meat-reduction, including proponents of technologically enabled alternative proteins such as plant-based meat analogues and cell-cultured meat products (Santo et al., 2020). Other meat reduction advocates have eschewed technological solutions, emphasizing instead the importance of moral persuasion to promote minimally processed plant-based dietary practice (Sexton et al., 2022).

On a parallel track, research at the consumer level has explored the influence of a range of demographic factors and psychological constructs as predictors of attitudes toward meat, plant-based foods, and novel alternative proteins. Literature reviews have highlighted greater openness to alternative proteins among young and highly educated individuals, those who are not politically conservative, those who live in urban areas, and those who are vegetarian and vegan; the effects of gender appear to differ across different types of alternative proteins, with men more open to cultured meat and women showing higher preferences for plant-based meats and meat reduction in general (Abdul Kareem et al., 2025; Onwezen et al., 2021; Onwezen & Dagevos, 2024). Importantly, the influence of demographic factors on alternative protein perceptions appears to vary widely across cultural and international contexts and are therefore best understood as influencing perceptions in combination with other classic drivers of food choice—such as awareness, taste, emotions, and consumers’ physical and social environments (Onwezen & Dagevos, 2024).

Other work has focused on consumers' psychological and cultural connections to meat as predictors of product-specific attitudes and behaviors. Joy (2011) coined the concept of "carnism" to describe an ideological belief system that conditions society to eat certain types of animals. Piazza et al. (2015) built upon Joy's (2011) framework and identified the "4Ns" that serve as prominent rationalizations of meat consumption—the beliefs that eating meat is *natural*, *normal*, *necessary*, and *nice*. That research found that people who endorsed the 4Ns tended to consume meat and animal products more frequently, were more highly committed to eating meat, and felt less guilty about their animal-product decisions than those who scored lower on those measures. Graça et al.'s (2015) work on meat attachment also explored these issues, with an eye toward the implications for the adoption of plant-based diets. Here, the researchers developed the Meat Attachment Questionnaire (MAQ) and found positive correlations between meat attachment, meat-eating behavior, and dietary identification as a meat consumer, as well as a negative correlation with self-identification as vegetarian or vegan. The concept of meat attachment and the MAQ have been used widely in recent scholarship on meat consumption and meat reduction interventions (Kwasny et al., 2022).

Additional scholarship has interrogated how consumer attitudes toward novel foods and new food technology influence perceptions of plant-based meat alternatives and cultured meat products. Research has demonstrated that concerns about these products' perceived lack of "naturalness" serve a key barrier for skeptical consumers (for a review, see Abdul Kareem et al., 2025). Consumers tend to associate naturalness with health and safety, while unnaturalness can create feelings of disgust and concerns about the potential for negative health consequences (Abdul Kareem et al., 2025). From a measurement perspective, the constructs of food neophobia (a reluctance to eat novel or unusual foods), food technology neophobia (reluctance to consume foods produced with novel technologies), and disgust sensitivity have emerged as important, if not always clearly consistent, predictors of consumers' willingness to try or purchase alternative proteins (Siegrist & Hartmann, 2020).

Amato et al. (2023) reviewed literature on both engaged stakeholder and consumer perceptions of alternative proteins, concluding that there were major attitudinal differences between these two groups. Notably, however, that research did not focus on perceptions of meat products, nor did it test its core claim about these between-group differences directly. This study aims to address this gap through an empirical test that examines whether those ideological dynamics identified as important to food system advocates also relate to consumer perceptions and behavioral intentions toward a range of meat products and meat alternatives.

Research Objectives

The primary objective of this research is to bridge the gap between conceptual frameworks focused on engaged stakeholders' positions on meat and meat alternatives, on one

hand, and consumer perception research, on the other. To operationalize Broad's (2023) advocate-focused framework in a consumer research context, we considered several different measures that might best capture the dynamics of 1) attachment to meat and 2) socio-technical imaginaries related to food systems. We prioritized validated scales that had been tested on samples of consumers. We decided on Graça et al.'s (2015) Meat Attachment Questionnaire (MAQ) as the most relevant measure for the first component, given its focus on diverse values related to enjoyment, emotional connection, dependence, and the right to eat meat. We opted for the Food Technology Neophobia Scale (FTNS) of Cox and Evans (2008) as the best existing measure for socio-technical imaginaries, given its focus on perceptions of necessity, trust, risk, and health.

Registered Study Plan and Deviations

We pre-registered our materials and study plan on the Open Science Framework (OSF) prior to accessing the data (see Ruby, 2023a); the questionnaires, dataset, and syntax are also available on the OSF (see Ruby, 2023b).

We made the following predictions:

- 1: Participants' attitudes will allow them to be classified along a two-axis continuum that ranges from A) high levels of meat attachment to low levels of meat attachment and B) techno-optimism to techno-pessimism. These clusters will be "high-tech vegans" (techno-optimists, low levels of meat attachment), "ecomodernists" (techno-optimists, high levels of meat attachment), "good foodies" (techno-sceptics, low levels of meat attachment); and "carnivore traditionalists" (techno-sceptics, high levels of meat attachment). We will also examine whether additional clusters can be identified, where participants score close to neutral on one or both of the key variables.
- 2: Meat attachment will negatively predict attitudes toward whole-food veggie burgers and plant-based meat, and positively predict attitudes toward conventional meat, cultured meat, and regenerative meat.
- 3: Food technology neophobia will negatively predict attitudes toward cultured meat and plant-based meat.

During the peer review process, reviewers noted that our first prediction is not falsifiable, and that we did not pre-specify the exact cutoffs for each quadrant. As such, they recommended that we focus less on the number of people that fall into each quadrant, and test whether meat attachment and food technology neophobia significantly interact when predicting attitudes toward the five different protein products. We have changed our analyses in response to this feedback and report the results below.

Method

Participants

We recruited participants via Prolific in August of 2023. Users registered in the USA and UK were invited to complete a pre-screener, indicating their current diet, age, gender, income, and role in purchasing groceries for their household. Those participants who indicated that they currently followed a vegetarian diet, vegan diet, or no specific diet were invited to participate in the main survey. We then recruited a total of 600 participants to complete a survey on “attitudes toward food, science, and technology”. We recruited from the US and UK due to linguistic and dietary similarities between the two countries, particularly related to alternative proteins (Driver et al., 2020). We sampled equal numbers of vegetarians, vegans, and omnivores to support a planned follow-up focus group study, ensuring enough participants from each dietary group to deeply investigate consumer perceptions of plant-based food innovation (Broad & Ruby, 2026). In line with Prolific guidelines, participants were paid a modest sum for their time.

To guard against careless responding, we screened for straight-lining responses (i.e., providing the same response to all questions across a measure) on the two core scales of the study—the Food Technology Neophobia Scale (Cox & Evans, 2008) and Meat Attachment Questionnaire (Graça et al., 2015). 18 participants displayed invariant responding for the Food Technology Neophobia Scale and six participants displayed invariant responding for the Meat Attachment Questionnaire. Excluding those who displayed invariant responding for either scale yielded a final sample of 581 participants. This final sample was gender-balanced (48% women), with most participants (88%) aged between 20 and 59 years of age. Most participants (77%) were regularly in charge of purchasing groceries for their household. For full demographic details, see the Supplement.

Materials

After indicating consent, participants completed a series of measures comprising food technology neophobia*, food neophobia, food-related lifestyle (involvement), meat attachment*, motivations to eat meat, general attitudes toward science and genetically modified organisms (GMOs), attitudes toward and willingness to pay for 5 different types of protein products (whole food veggie burgers, conventional meat, plant-based meat, cultured meat, regenerative meat)*, and demographics* (*indicates inclusion in the present manuscript, with details provided below). Sections of the questionnaire not discussed in the present manuscript are expected to be used in a separate manuscript focusing on motivations to eat meat.

The study, which conformed to the Declaration of Helsinki, was approved by the Human Ethics Committee of Author 1’s university (HEC23235, approved 1 August 2023). Participants indicated consent before beginning both the pre-screener and the survey. The median time to complete the survey was 15 minutes.

Food Technology Neophobia

Participants completed the 13-item Food Technology Neophobia Scale (FTNS) from [Cox and Evans \(2008\)](#), using a 5-point agree/disagree scale. Sample items include “It can be risky to switch to new food technologies too quickly” and “New food technologies give people more control over their food choices” (reverse-scored). Past research ([Cox & Evans, 2008](#); [Evans et al., 2010](#)) has demonstrated that the Food Technology Neophobia Scale has high stability over time and high internal reliability ($\alpha = .83$). Internal reliability in our sample was also high ($\alpha = .87$).

Meat Attachment

Participants completed the 16 item Meat Attachment Questionnaire (MAQ; [Graça et al., 2015](#)), using a 5-point agree/disagree scale. Sample items include “Meat is irreplaceable in my diet” and “I would feel fine with a meatless diet” (reverse-scored). [Graça and colleagues \(2015\)](#) demonstrated that the Meat Attachment Questionnaire has high internal reliability ($\alpha = .92$) and moderate to strong correlations with measures of meat consumption frequency and the extent to which people identify as meat consumers. Internal reliability in our sample was also high ($\alpha = .97$).

Attitudes Toward and Willingness to Try Protein Products

Each participant answered questions about five different protein products, in a random order: whole-food veggie burgers, conventional meat, plant-based meat, cultured meat, and regenerative meat.

For each product, participants were asked if they had heard of it before, then presented a brief description. Descriptions were developed by consulting existing literature, as well as websites of advocacy groups and journalistic coverage of the topic, then refined using a cognitive interviewing technique conducted by members of the research team with consumers. Efforts were made to provide factual information without clear value judgements, with a recognition that some products were likely less familiar to subjects and required more detail (see Supplement).

Participants then indicated whether they have tried the product before, and how likely they were to try it in future if it were available for sale, on a scale from 1 (not at all likely) to 5 (extremely likely). For cultured meat, participants were not asked if they had tried it before, given its limited availability, but did indicate how likely they were to be in favor of others eating it, using the same 5-point scale.

Finally, using a 5-point response scale, they rated their perceptions of each product on 10 bipolar traits: Unhealthy / Healthy, Unnatural / Natural, Bad for the environment / Good for the environment, Unsafe / Safe, Expensive / Affordable, Bad for animals / Good for animals, Bad for farmers / Good for farmers, Bad for the economy / Good for the economy, Not nutritious / Nutritious, Disgusting / Not disgusting. We computed a composite attitude score for each protein product by averaging scores on these 10 dimen-

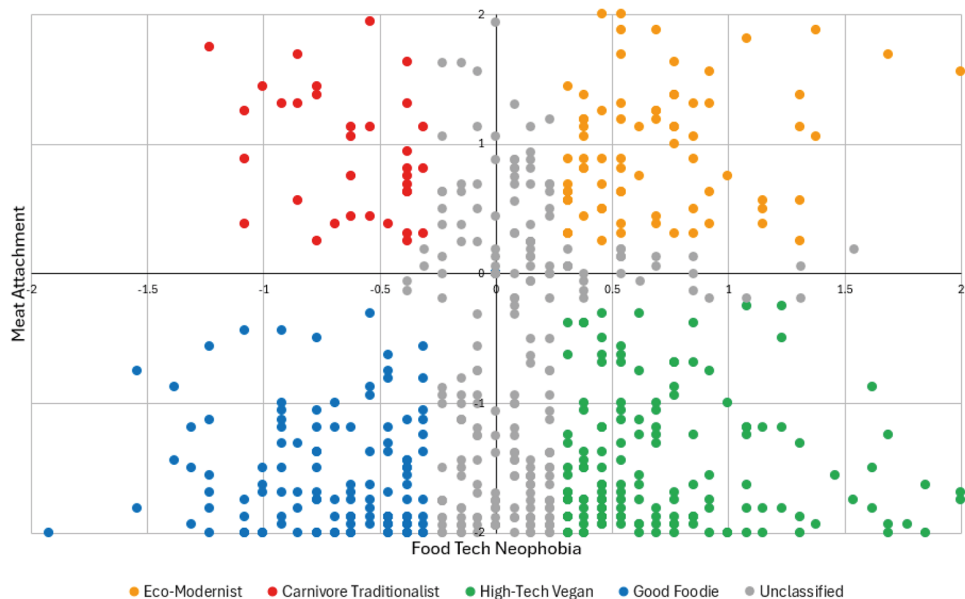
sions. Internal reliability was high (whole-food veggie burgers $\alpha = .91$, conventional meat $\alpha = .90$, plant-based meat $\alpha = .89$, cultured meat $\alpha = .89$, and regenerative meat $\alpha = .92$).

Results

Consumer Clusters

Possible mean scores for both Food Technology Neophobia and Meat Attachment ranged from -2 (lowest) to 2 (highest). We classified scores of ≥ 0.25 as high, and scores of ≤ -0.25 as low, and all scores in the middle of the scale as neutral. Classification was conducted following Broad’s (2023) framework and using the above cutoffs, rather than conducting an exploratory analysis to detect clusters among participants. Participants were classified into four different groups (see Figure 1): High-Tech Vegans (low FTN, low meat attachment; $n = 141$), Eco-Modernists (low FTN, high meat attachment; $n = 75$), Good Foodies (high FTN, low meat attachment; $n = 116$), and Carnivore Traditionalists (high FTN, high meat attachment; $n = 34$). Roughly 1/3 of participants ($n = 215$) did not fall into any of the 4 groups because they had scores near the mean on one of the two variables.

Figure 1
Consumer Clusters



Meat Attachment, Food Technology Neophobia, and Attitudes Toward Protein Products

We conducted a series of 5 regressions, predicting attitudes toward each of the protein products from participant food technology neophobia, meat attachment, and the interaction between the two (see Table 1 for full details). We also tested differences between the standardized regression coefficients using linear hypothesis tests. For ease of interpretation, all variables were standardized for these regression analyses.

Table 1
Predictors of Attitudes Toward Protein Products (All Variables Standardized)

Protein Product	Predictor	R^2_{adj}	F	β	t	p
Whole-food veggie burger		.23	58.02			< .001
	Food Tech Neophobia			-0.07	-1.86	.064
	Meat Attachment			-0.47	-12.564	< .001
	FTN * MA			-0.03	-0.91	.361
Conventional meat		.40	131.82			< .001
	Food Tech Neophobia			-0.06	-1.76	.079
	Meat Attachment			0.64	19.75	< .001
	FTN * MA			0.02	0.79	.430
Plant-based meat		.20	48.68			< .001
	Food Tech Neophobia			-0.25	-6.53	< .001
	Meat Attachment			-0.34	-9.14	< .001
	FTN * MA			-0.06	1.74	.082
Cultured meat		.18	42.27			< .001
	Food Tech Neophobia			-0.41	-10.82	< .001
	Meat Attachment			-0.06	-1.70	.090
	FTN * MA			-0.02	-0.51	.611
Regenerative Meat		.24	62.97			< .001
	Food Tech Neophobia			-0.03	-0.85	.395
	Meat Attachment			0.49	13.54	< .001
	FTN * MA			0.04	1.22	.223

As predicted, meat attachment positively predicted attitudes toward conventional meat and regenerative meat, and negatively predicted attitudes toward whole-food veggie burgers and plant-based meat. Contrary to predictions, it did not significantly predict attitudes toward cultured meat.

Also as predicted, food technology neophobia negatively predicted attitudes toward cultured meat and plant-based meat. It did not significantly predict attitudes toward any of the other protein products.

The interaction between food technology neophobia and meat attachment was not significant in any of the five regressions.

The strength of the regression coefficients did not differ in the regression predicting attitudes toward plant-based meat $F(1, 577) = 2.98, p = .085$. Meat attachment was a significantly stronger predictor than food technology neophobia in predicting attitudes toward whole-food veggie burgers, $F(1, 577) = 51.43, p < .001$, conventional meat, $F(1, 577) = 205.09, p < .001$, and regenerative meat, $F(1, 577) = 91.84, p < .001$. In contrast, food technology neophobia was a stronger predictor than meat attachment in predicting attitudes toward cultured meat, $F(1, 577) = 37.16, p < .001$.

Exploratory Analyses

We also examined whether meat attachment and food technology neophobia were correlated with attitudes and likelihood of trying the five protein products at the univariate level, by examining Pearson’s correlation coefficients.

Meat attachment negatively correlated with likelihood of trying and attitudes toward whole-food veggie burgers and plant-based meat, and positively correlated with likelihood of trying and attitudes toward conventional meat, cultured meat, and regenerative meat (see Table 2).

Table 2
Correlates of Evaluation and Likelihood of Trying Protein Products

	Meat Attachment			Food Tech Neophobia		
	<i>r</i>	95% CI	<i>p</i>	<i>r</i>	95% CI	<i>p</i>
Whole-food veggie burger						
Evaluation	-.48	-.54, -.41	< .001	-.12	-.20, -.04	.004
Likelihood of trying	-.63	-.68, -.58	< .001	-.10	-.18, -.02	.012
Conventional meat						
Evaluation	.63	.58, .68	< .001	.02	-.07, .10	.712
Likelihood of trying	.79	.76, .82	< .001	.01	-.07, .09	.773
Plant-based meat						
Evaluation	-.38	-.44, -.30	< .001	-.28	-.35, -.20	< .001
Likelihood of trying	-.51	-.56, -.44	< .001	-.30	-.48, -.35	< .001
Cultured meat						
Evaluation	-.11	-.19, -.03	.006	-.42	-.48, -.35	< .001
Likelihood of trying	.19	.11, .27	< .001	-.30	-.37, -.22	< .001

	Meat Attachment			Food Tech Neophobia		
	<i>r</i>	95% CI	<i>p</i>	<i>r</i>	95% CI	<i>p</i>
Regenerative meat						
Evaluation	.49	.43, .55	< .001	.02	-.06, .10	.589
Likelihood of trying	.74	.70, .77	< .001	.02	-.06, .10	.666

In contrast, food technology neophobia was negatively correlated with likelihood of trying and attitudes toward whole-food veggie burgers, plant-based meat, and cultured meat, and unrelated to likelihood of trying and attitudes toward conventional and regenerative meat.

Discussion

Summary of Findings and Interpretations

The primary aim of this paper was to examine ideological characteristics that shape consumer perspectives of varied forms of meat and alternative proteins. The work attempted to assess the extent to which conceptual frameworks that were developed to explain the landscape of stakeholder debate on the topic of the future of meat and animal food production would empirically align with the perceptions of everyday consumers.

Our first prediction was that participants’ attitudes would allow them to be classified along a two-axis continuum; following the terminology of Broad (2023), this ranged from A) high to low levels of meat attachment and B) techno-optimism to techno-pessimism, resulting in their placement in one of four clusters—“high-tech vegans” (techno-optimists, low levels of meat attachment), “ecomodernists” (techno-optimists, high levels of meat attachment), “good foodies” (techno-skeptics, low levels of meat attachment); and “carnivore traditionalists” (techno-skeptics, high levels of meat attachment). The modest correlation between these variables makes them amenable to such a classification, because there are relatively even numbers of people in each quadrant. Among the remaining participants who did not slot into a pre-defined cluster based on a cutoff of ±0.25, 28% were categorized as either high or low meat attachment (neutral on food technology neophobia), with the small number of remaining participants either high or low on food technology neophobia (neutral on meat attachment) or completely neutral. This suggests that meat attachment is a particularly strong force in shaping consumer identity, supporting the arguments of psychological scientists who have emphasized the importance of this characteristic (Graça et al., 2015; Joy, 2011).

Our second prediction was that meat attachment would predict consumer attitudes toward five distinct products—conventional meat, regenerative meat, whole-food veggie burgers, plant-based meat, and cultured meat. As predicted, there was a significant

positive association between levels of meat attachment and assessments of both conventional and regenerative meat, as well as a significant negative relationship with attitudes toward whole-food veggie burgers and plant-based meat. Notably, in the regression analysis, meat attachment was not significantly associated with assessments of cultured meat, but on a univariate level it was weakly negatively associated.

Our third prediction, that food technology neophobia would negatively predict attitudes toward both cultured meat and plant-based meat, was fully supported. Notably, the lack of significant effects in either direction with respect to food neophobia's connection to the other three products—conventional meat, regenerative meat, and whole-food veggie burgers—provides further validation of the construct's relevance. Regenerative meat and whole-food veggie burgers explicitly rely on narratives of naturalization that position the products in opposition to large-scale industrial food production and highly processed foods (McGregor & Houston, 2018). The appeal of these products will likely remain strong among those who hold concerns about the role and impact of novel technology in the food system. Despite the massive scale and high levels of technology used in conventional animal food production, food technology neophobia was not predictive of consumer attitudes toward these products. This is possibly because the ubiquity of conventional meat has created a sense that the system is normal and perhaps even somewhat natural. Strategies to manage cognitive dissonance may also play a role in this context, where consumers prefer to not think too much about a system that they rely on for their food but which, upon closer inspection, might present concerning elements (e.g., Buttlar et al. 2023; Piazza et al., 2015; Rothgerber & Rosenfeld, 2021).

Importantly, meat attachment and food technology neophobia did not significantly interact when predicting attitudes toward any of the five different protein products. This indicates that the association between meat attachment and product attitudes was comparable among individuals with high versus low trust in food technology. This suggests that, when understanding consumer attitudes toward different protein products, it is likely more useful to focus on continuous measures of people's attachment to meat and their (dis)trust of food technology, rather than whether one could classify them as, for example, carnivore traditionalists or eco-modernists.

In terms of the practical implications of this work, advocates for meat reduction have tended to make a two-fold case with respect to meat and alternative proteins. First, they have attempted to reduce the public's levels of meat attachment and combat the rationalizations used to support meat consumption (e.g., Hopwood et al., 2021; Joy, 2011; Piazza et al., 2015); second, they have attempted to promote alternatives to animal products, including both whole-food vegetarian alternatives and higher-tech plant-based and (potentially) cultured meat alternative proteins (Onwezen & Dagevos, 2024; Sexton et al., 2019). This research suggests that these efforts have a long way to go, given that meat attachment remains a major barrier to the uptake of these alternatives, including plant-based products that have positioned themselves as a type of "meat" that is simply

made in a different way, with plant inputs rather than animal ones (Broad, 2020). Indeed, a recent meta-analysis by Green et al. (2025) indicates that how best to meaningfully reduce people's meat consumption remains an unsolved problem. In other qualitative research on this topic, we have further outlined the multi-level challenge of novel plant-based meat alternative adoption, which depends on reinforcing influences at the level of the individual, their interpersonal networks, local food environment, and broader culture (Broad & Ruby, 2026).

Strengths and Limitations

In this pre-registered study, we recruited a large, gender-balanced sample of omnivores, vegetarians, and vegans from both the US and UK. Although this has the advantage of gathering data from participants who differ greatly from one another in terms of their dietary attitudes and practices, veg*ns comprised 2/3 of the sample and thus the average levels of meat attachment would not be representative of the general populations of the US and the UK. As the US and UK are both considered WEIRD cultures (Henrich et al., 2010), the results may not generalize to other cultural contexts, particularly those where the average resident is less strongly attached to meat. As with many studies on consumer attitudes toward food products, an important limitation is that participants provided self-report data, rather than being asked to try specific foods in a controlled laboratory setting. In addition, while we attempted to offer fact-based and unbiased information about each of the products in question, we recognize that specific terminology and phrasing may have influenced respondents' perceptions in ways that were unintended and difficult to assess. For example, we used the word "slaughter" in descriptions of both plant-based meat and cultured meat but did not use this word when describing conventional meat. Had we done so, it is possible that participants may have evaluated conventional meat more negatively than they did (see Rothgerber & Rosenfeld, 2021). Finally, although we screened out participants who demonstrated straight-lining in their responses, we did not employ dedicated attention checks, meaning that we cannot be certain that all participants were fully reading the descriptions of the different products.

Conclusion

This study empirically tested a conceptual framework outlined by Broad (2023), which asserted that engaged stakeholder debates related to different types of meat and alternative proteins could be understood as an interaction between levels of meat attachment and socio-technical imaginaries. With a focus on consumers in the US and UK, our research found that consumers' attitudes toward protein foods appear less related to how they feel about the technologies used to make them, and more linked to how attached they are to eating meat, with the notable exception of cultured meat. Ultimately, the power of meat attachment demonstrated in these findings offers sobering implications

for anyone invested in efforts to reduce meat consumption on account of environmental, ethical, or public health considerations. With that said, the weak negative link between meat attachment and attitudes toward cultured meat is potentially encouraging, as it suggests that even consumers highly attached to meat might accept this product if it reaches market viability and comes to be accepted as a type of “real meat” in its own right.

This research adds to the growing body of scholarship on attitudes toward meat and alternative proteins, offering a unique perspective in its efforts to link in its efforts to link critically-oriented and conceptual scholarship on the topic with empirical assessments of consumer perceptions. Future research might build on this work by examining these dynamics in other global contexts, especially those where ideological commitments to meat attachment and perceptions of food technology might differ from that of the US and UK. Those engaged in practical advocacy efforts to reduce meat consumption or promote alternative proteins might also keep these findings in mind, developing strategic communication strategies that consider meat attachment and socio-technical imaginaries as relevant characteristics to be addressed.

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Competing Interests: Matthew B. Ruby serves as a volunteer board member for the Society for the Psychology of Human-Animal Intergroup Relations (PHAIR), an international organization that aims to advance and promote scientific research and education on a wide range of topics related to how people perceive, treat, and interact with non-human animals, including the consumption of plant-based vs. animal-derived products, animal advocacy, and veganism. Garret Broad serves as a volunteer board member for the Plant Based Foods Institute, a non-profit organization focused on advancing sustainable plant-based food and agricultural solutions.

Author Contributions: *Matthew B. Ruby*—Conceptualization | Data curation | Formal analysis | Funding acquisition | Investigation | Methodology | Visualization | Writing – original draft | Writing – review & editing. *Garrett Broad*—Conceptualization | Funding acquisition | Methodology | Writing – original draft | Writing – review & editing.

Ethics Statement: This study was approved by La Trobe University’s Human Ethics Committee (approval HEC23235) and conducted in accordance with the Declaration of Helsinki.

Data Availability: The data are available on the OSF (see [Ruby, 2023b](#)).

Supplementary Materials

For this article, the following Supplementary Materials are available:

- Study registration plan (see [Ruby, 2023a](#))
- Study data, syntax, and questionnaire (see [Ruby, 2023b](#))
- Expanded participant demographics, full protein product descriptions, power calculations, specific details about the analytic approach, suggestions for future research, generalizability constraints (see [Ruby & Broad, 2026](#))

Index of Supplementary Materials

Ruby, M. B. (2023a). *Supplementary materials to "Consumer attitudes toward conventional, regenerative, plant-based, and cell-cultured meat: The role of meat attachment and food technology neophobia"* [Preregistration]. OSF. <https://osf.io/apqrh>

Ruby, M. (2023b). *Public attitudes toward alternative proteins: The role of meat attachment and (dis)trust in technology in shaping consumer communities* [Data, syntax, questionnaires]. OSF. <https://osf.io/u53ma>

Ruby, M. B., & Broad, G. (2026). *Supplementary materials to "Consumer attitudes toward conventional, regenerative, plant-based, and cell-cultured meat: The role of meat attachment and food technology neophobia"* [Additional materials]. PsychOpen GOLD. <https://doi.org/10.23668/psycharchives.22243>

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