The relative influence of perceived processing level alongside nutrition, health, sustainability and price on consumer decision-making for meal-replacement products: A conjoint analysis

Natalie Rouse [a,*], James Collier [b], Louise Neilson [d], Chloe Mellor [a], Emilia Urbanek [c], Michelle Lee [a], Jennifer Gatzemeier [a], Laura L. Wilkinson [a]

[a] School of Psychology, Faculty of Medicine, Health, & Life Science, Swansea University, Swansea SA2 8PP, UK
[b] Huel, Unit 6 Icknield Way Industrial Estate Icknield Way, Tring HP23 4RN
[c] School of Biosciences, Geography, Physics, Swansea University, Swansea, SA2 8PP, UK
[d] Twisted Orange, 14 Ballard Grove Sidford, Sidmouth, EX10 9EP, UK

ARTICLE INFO

ABSTRACT

Consumer appeal for healthier and sustainable food options, that still provide convenience, is growing. Many of these products fall under the category of "ultra-processed foods" (UPF), which has faced widespread criticism. Moreover, emerging evidence shows heterogeneity within this so-called "UPF" category, making it potentially challenging for consumers to navigate. Yet there is limited understanding of consumer perceptions of UPF. Therefore, this pre-registered online study investigated how the term UPF influenced decision making around food products that are commercially positioned as healthier or more nutritious options than current convenience products. A total of 302 participants (56.1% male; M age = 38.8±12.5 years) completed a conjoint choice-based task involving four unbranded commercially available product formats: Bar, Savoury Meal, Meal Replacement Powder, and Ready-to-Drink. They were shown five attribute categories: processing level, nutritional claims, health messaging, sustainability, and price. The results indicated that the level of processing was the most critical attribute for product selection overall, followed by price, with price being the most influential in only the bar format. Nutritional claims and health messaging were consistently less influential, with sustainability ranked lowest. These findings emphasise the central role of processing in shaping consumer preferences. The results can be used to inform industry, academia, government initiatives and consumers. Future studies may also consider manipulating the nutritional composition of test products, as classification as 'ultra-processed' here was based on formulation and existing categorisation systems rather than nutritional quality.

1. Introduction

In recent years, consumer food product preference has shifted towards healthier and more sustainable options, driven by increasing awareness of the environmental effects caused by current food systems and a rising demand for nutrient-rich foods (Kenny et al., 2023), whilst maintaining convenience. The food industry has responded by developing food products that seek to meet this demand (Daas et al., 2024) including, for example, fortified products (Kroker-Lobos et al., 2022) that prioritise convenience. These types of products can enhance

sustainability by mitigating environmental impacts through efficient ingredient use and extended shelf life, which reduces energy requirements for storage and preparation (Eneroth, 2023). However, concerns have also been raised that such products can be classified as "ultra-processed" (Jones, 2019; Labonté et al., 2017; Sandall et al., 2023).

The term ultra-processed foods (UPF) is used across several food classification frameworks (de Araújo et al., 2022), with the most widely used being the NOVA system by Monteiro et al. (2018). Across these classifications, food products have been termed "ultra-processed" based

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on the degree of processing undergone rather than analysis of nutritional content (Gonzales Santos et al., 2024; Knorr & Augustin, 2021; Petrus et al., 2021). While processing may be considered, one of the main criticisms of these classification systems are their broad and ambiguous definitions which can cause confusion among consumers (Lockyer et al., 2023; Mialon et al., 2018; Sadler et al., 2021; Sarmiento-Santos et al., 2022). The lack of a universally accepted definition for foods that have undergone processing makes it challenging for consumers, media, academics and industry to apply and interpret consistently (Gibney, 2019; Monteiro et al., 2018).

Indeed, food products classified as UPF seem to vary significantly in their level of processing and nutritional profile (Abreu & Liz Martins, 2023; Derbyshire, 2019; Huybrechts et al., 2022; Vale et al., 2024). While UPFs often contain high levels of added sugars, unhealthy fats, salt, and artificial additives, this is not always the case (Forde et al., 2020; Weaver et al., 2014). Moreover, there seems to be heterogeneity in findings considering the relationship between UPF consumption and health outcomes contributing to confusion. For example, Duan et al. (2022) classified foods according to UPF definitions and identified four distinct consumption patterns. Two of these patterns, dominated by cold and warm savoury snacks, were associated with an increased risk of type 2 diabetes. In contrast, a pattern characterised by Dutch meal foods showed no significant association, while another, centred on sweet snacks and pastries, was paradoxically associated with a reduced risk of type 2 diabetes. This highlights that not all UPFs may confer the same health risks, challenging the notion of UPFs as a uniform dietary category.

Furthermore, while higher consumption of processed animal-based products has been consistently linked with increased disease risk, other processed foods, such as bread, cereals, and plant-based alternatives, have not shown the same negative associations on health (Cordova et al., 2023). Yet, evidence remains conflicting and inconclusive. For instance, Rauber et al. (2024) classified foods as ultra-processed and found that plant-based UPF (commonly positioned as healthier and more sustainable than foods of animal origin) were linked to an elevated risk of cardiovascular disease. Additionally, Cairat et al. (2024) further emphasise the complexity of these associations, demonstrating that the positive correlation between processed food consumption and breast cancer risk was primarily attributable to alcohol intake rather than food processing itself.

As a consequence of these contradictory findings, consumers are left to navigate mixed information, highlighting the complexity of modern dietary choices consumers must make. Compounding this issue is the general lack of understanding and definition regarding what qualifies as UPF, with perspectives varying between countries, within scientific literature, media discourse and the food classifications themselves (Adams & White, 2015; Braesco et al., 2022). In the UK, Robinson et al. (2024) surveyed adults to assess the perception and awareness of the term UPF and the influence that this awareness had on dietary behaviours. The majority of participants were familiar with the term, and over half reported considering "UPF" status when selecting foods. The research found that awareness and avoidance of food they perceived as UPFs was more common among individuals from higher socioeconomic status (SES) backgrounds. Despite this awareness, many participants frequently misclassified foods as UPFs. Additionally, exposure to information highlighting UPF-related health risks has heightened consumers' negative perceptions and discouraged UPF consumption. By contrast, Bolhuis et al. (2024) found that Dutch consumers maintained more neutral and nuanced attitudes towards industrial food processing. In their survey, individuals with professional or educational connections to food exhibited more positive views on industrial processing, suggesting that greater knowledge may influence attitudes.

These findings draw attention to the diversity of consumer perceptions of UPFs and that the inherent complexity is adding confusion to dietary choices. Other factors often found to influence dietary choice are nutrition, health, price and sustainability (Fernqvist et al., 2024;

Rampalli et al., 2023). Gaining insight into how consumers manage trade-offs between these factors and level of processing is essential for developing effective communication strategies and products that better align with evolving consumer values and preferences. Further research into how consumers prioritise attributes could aid public health initiatives by encouraging more informed, healthier choices that meet the complex needs of modern consumers, and support manufacturers to create products which align more to these needs. This emphasises the importance of research in understanding how consumers weigh different food attributes during decision-making.

Conjoint analysis, a validated statistical technique used to assess the value consumers place on various product attributes (Agarwal et al., 2015), is a quantitative experimental methodology uniquely placed to simulate the complexity of real-world decision-making processes and identify the key factors that influence consumer choices (Ben-Akiva et al., 2019).

Therefore, the present study aimed to assess the relative importance of five product attributes 1) level of processing, 2) health messaging, 3) nutrient claims, 4) sustainability messaging, and 5) price for selection of four commercially available convenience meal replacement product formats, using conjoint analysis to quantify these preferences.

1.1. Hypotheses

H1: A higher level of processing (moving away from unprocessed/minimally processed) will negatively impact conjoint utility scores irrespective of product format.

H2: Price will be the most significant driver of consumer choice, yielding the highest attribute importance scores irrespective of format. Despite their prominence in marketing trends, health, nutrition and sustainability will have the least impact compared to other attributes.

2. Methods

2.1. Participants and Recruitment

This study was preregistered on the Open Science Framework (OSF; https://osf.io/eusqf). Participant recruitment was time-phased across a mixture of morning, evening and weekend slots to avoid bias using the *Prolific* volunteer database (https://www.prolific.co/). To ensure data quality and reduce the risk of fraudulent or automated responses, we used Prolific, which includes built-in participant screening and verification procedures.

The target sample size was 300 participants, 302 started and completed the study via Prolific. With large effect sizes of $\delta \geq 0.10$, the literature shows that conjoint experiments reach the 0.8 power threshold with relatively small samples (n = 300) and a low number of tasks (Stefanelli & Lukac, 2020). This also aligns with the median sample size of 297 for conjoint analysis (Pentus, 2023).

Participants were required to meet the eligibility criteria which included being over 18 years of age, living in the UK and providing written consent for the study via an online tick-box form.

This research was approved by the School of Psychology Research Ethics Committee at Swansea University (review reference 2 2024 9028 8701, 30/04/2024).

2.2. Measures

2.2.1. Conjoint analysis

Choice-Based Conjoint (CBC) analysis, presents participants with varying product configurations and reveals the trade-offs consumers are willing to make (Moskowitz & Moskowitz, 2012). This process captures data on participants' preferences for different product attributes at varying 'levels' and highlights which attribute and at what 'level' they deem most important. Conjointly software was utilised to execute the conjoint analysis (Conjointly, 2024).

In this experimental design, participants were presented with combinations of product attribute levels that may realistically occur (apart from processing level which was our manipulation) for four common food product formats as in **Figure 1**. They were asked to select their preferred option from a set of three combinations which were generated by *Conjointly*. After each selection, the displayed options changed and repeated. On average, participants selected their preferred option 12 times for each product. Each screen change showed three more generated combinations of attributes, resulting in approximately 36 different combinations of attributes of each product being evaluated.

The conjoint analysis software used a built-in algorithm to identify the most selected or most rejected options. It then dynamically adjusted the three displayed options, presenting new attribute combinations. Each participant completed a separate conjoint experimental block for each of the four food product formats: Meal Replacement Powder (MRP), bottled Ready-to-Drink (RTD), Meal Replacement Bar, and Savory Meal. While these formats exist in the meal replacement market, the particular product attribute/ attribute level combinations within this study were fictional, as clarified in the debrief form. The primary goal of this approach was to identify the attributes, attribute levels and combinations of these that drive consumer appeal.

There were five attributes, which included the level of processing, health messaging, nutritional claims, sustainability, and price per serving; each with four levels (**Table 1**). Participants were asked to select their preferred product comprised of a combination of these attributes/ attribute levels. Their choices then generated a relative attribute importance score and a utility score reflecting their 'level' preferences.

2.2.2. Quantitative questionnaire measures

The measures recorded in the questionnaire included demographic information; age, gender, ethnicity, employment status, income, education level, and dietary pattern followed. The dietary patterns question was modified from the OMNIPLaNT survey with 5 responses with a short description. The 5 options are reduced from OMNIPLaNT's 8 to combine the sub-sectors within vegetarian diets. The options were; "Vegan" (a diet and lifestyle that excludes all animal products), "Vegetarian" including lacto, ovo and lacto-ovo (a diet that excludes meat, fish, and poultry), "Pescatarian" (a diet that avoids meat and poultry but includes fish and seafood), "Omnivore" (a diet that includes both plant-based and animal-based foods), and "Other" with open response option.

The validated surveys used to assess participants' eating behaviours and perceptions were a modified version of The Eating Motivation Survey (TEMS; Renner et al., 2012), which comprised of 31 'items' including the addition of 3 adapted items on "Processing", and The Food Neophobia Scale (FNS; Pliner & Hobden, 1992), which comprises of 11 questions.

The Food Ratings Score (FRS; Michel et al., 2021) was used to collect the perception and previous exposure of participants to the four product formats. The FRS is composed of 7 questions using a 0-100 sliding scale (from low to high) for product familiarity, taste, healthiness, naturalness, convenience, liking, and desirability. Alongside the questions was an unbranded visual representation of each product and a brief description. A full list of these measures can be found on the OSF (https://osf.io/eusqf).

2.2.3. Qualitative question

Participants were first asked whether they were familiar with the term "Ultra-Processed Food (UPF)" and given the option to respond with either "Yes" or "No." This was followed by an open-ended, unlimited-word response question: "What does the term "Ultra-Processed Food (UPF)" mean to you?" allowing participants to share their understanding
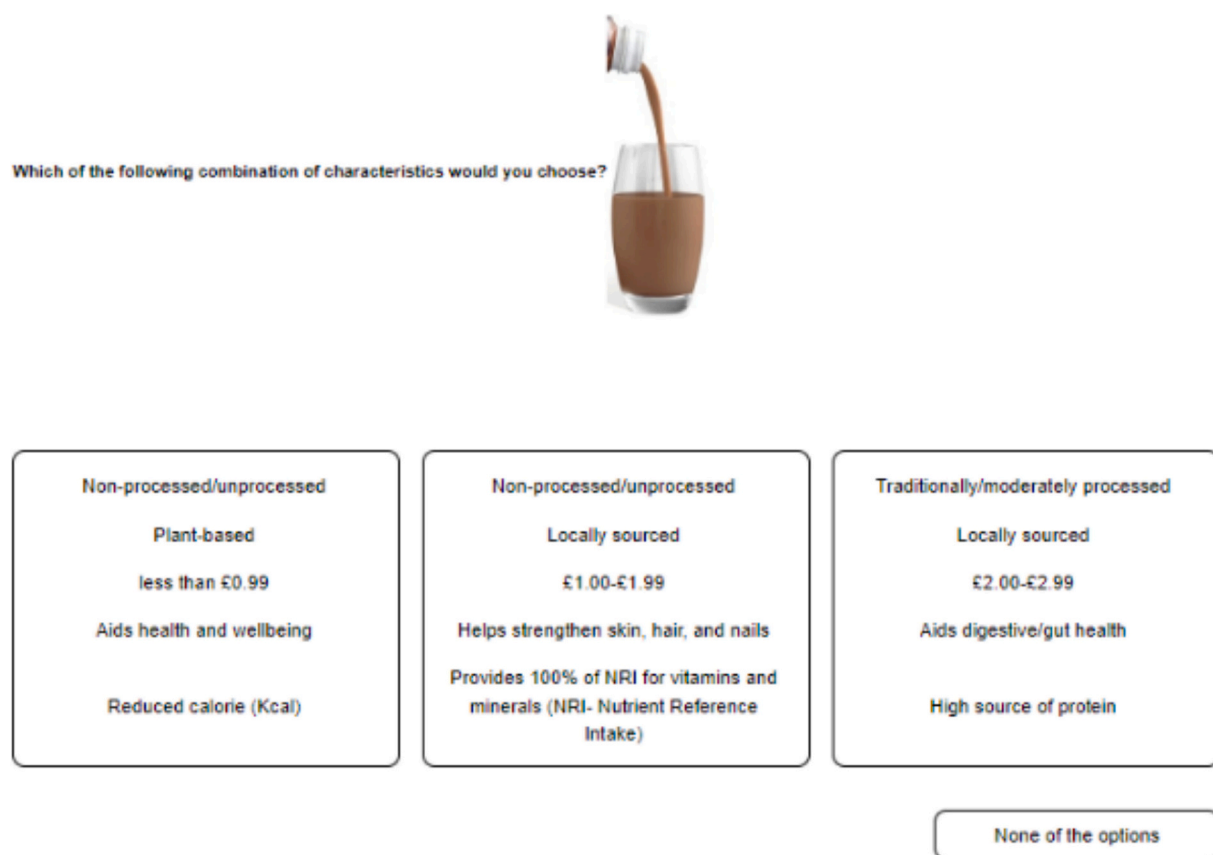

Figure 1. Example of CBC task showing 3 product options. The participant clicks on their preferred option. This task repeats on average 12 times to detect which attribute(s) and attribute levels influence the participant's selection.

Table 1

Attributes and levels for each CBC experiment.

Attributes and Levels				
Processing Level	*Nutritional Claim*	*Health Messaging*	*Sustainability*	*Price per Serving*
1) Non-processed/unprocessed	1) Contains 100% of daily NRI* vitamins and minerals	1) Contributes to the growth and development of muscle	1) Carbon neutral/CO_2/low carbon footprint	1) <£0.99
2) Minimally processed	2) High in protein	2) Supports digestive and gut health	2) Plant-based	2) £1-£1.99
3) Traditionally/moderately processed	3) Reduced calorie (Kcal)	3) Aids health and well-being	3) Locally sourced	3) £2-£2.99
4) Ultra-processed food	4) Low fat	4) Helps strengthen skin, hair, and nails	4) Recycled/recyclable packaging	4) £3-3.99

* NRI= Nutrient Reference Intakes are the quality of protein, carbohydrates, fats, fibre, vitamins and minerals defined by the Food Standards Agency required daily for healthy adults. Kcal = One kilocalorie (term is interchangeable with calories).

or perception of the term, regardless of their prior familiarity with it.

2.2.4. Procedure

Participants were provided with a Participant Information Sheet detailing the study's structure, including a cover story suggesting that the study was investigating the key factors that determine consumer food product choices and establishing what the ideal food product combination is within a cross-section of participants. The cover story was to minimise bias from demand characteristics. They were then directed to a consent form, which was required for study participation. If the participants did not want to continue they were instructed to close their browser. The study was estimated to take approximately 25 minutes. Participants who consented to take part in the study completed a series of four CBC tasks, one for each product format. After completing the CBC tasks, participants were directed to a questionnaire that collected demographic information, questionnaires and questions to assess eating behaviours, attitudes, and perceptions. Upon completion, participants were provided with a debrief form and directed back to Prolific to finalise the survey and receive payment (£5.50) to compensate them for their time.

2.3. Data Analysis

2.3.1. Conjoint Analysis

Conjoint analyses were conducted within the web-based *Conjointly* platform as follows;

Relative importance: the relative importance of each attribute indicates how influential it is compared to other attributes, with all values summing to 100%. Similarly, the levels within attributes are calculated by *Conjointly* to establish the average preference scores for each level, which are used to calculate the relative importance of different levels within each attribute.

Utility Score: The utility score, also referred to as level values, or conjoint analysis utilities, represents numerical values that quantify the significance of each level of an attribute in a participant's decision-making process. These scores reflect the relative preference or importance of each attribute level. These scores highlight the most influential factor(s) driving consumer decisions. More favoured levels are given higher scores, while those that are less preferred receive lower scores. The score ranges from -100 to +100, where a higher negative score indicates a stronger aversion to the attribute or level, and a more positive score reflects greater appeal. Each attribute is scaled so that the sum of all positive values equals the absolute sum of all negative values. However, these scores are relative. Consequently, adding a new level to an attribute would adjust the relative value of each existing level.

McFadden's pseudo-R^2 assesses how well the CBC survey model fits respondents' choices, reflecting the goodness of fit. A high pseudo-R^2 value (above 65%) indicates strong alignment, suggesting clear and consistent preferences among respondents. In contrast, a low pseudo-R^2 value (below 45%) suggests a weaker fit, indicating that choices are more random or inconsistent.

2.3.2. Mixed Methods Analysis of Open Response Items

Qualitative data were analysed by categorising responses with similar meanings to create a coding framework, and the frequency of each categorised word or phrase was counted to provide a quantitative assessment of theme occurrence. To further explore variations in understanding, responses were divided into two groups: those from participants familiar with the term "ultra-processed foods" and those who were not.

To ensure a rigorous analysis, a second researcher (CM), who has previous experience analysing mixed methods data, independently coded the data using the coding framework created by the first author. Following the approach by McAlister et al. (2017), inter-rater reliability was calculated by dividing the number of agreed codes by the total number of codes assigned and expressing this as a percentage. Discrepancies in interpretation were discussed at intervals, and where consensus was reached, the coding framework was refined accordingly. All data were then reviewed and recoded where necessary to reflect these updates for both qualitative and quantitative analyses.

3. Results

3.1. Participant characteristics

3.1.1. Demographic data

In total, 302 responses were recorded for the conjoint study which were complete and met eligibility criteria. Participants included 56.1% males and 43.9% females, with a mean age of 38.8 years (SD = 12.5). Additional sample characteristics are summarised in **Table 2.**

3.1.2. Psychological characteristics

The average Food Neophobia Score (FNS) among participants was 38.8 (SD = 6.81). This score falls within the moderate range compared to the general population, where typical FNS scores range from 20 to 60, with scores above 40 often indicating higher levels of food neophobia, and scores below 30 indicating lower levels (Pliner & Hobden, 1992).

Participants' eating motivation, as measured by the modified TEMS, showed variation across different factors (**Table 3**). Our results showed "Need and Hunger" having the highest mean score with "Processing" having the lowest. Comparatively, Hartmann and Siegrist (2017) highlighted differing eating motivations across countries, of the items measured; the mean scores from USA, Germany and India scores saw "Liking" and "Need and Hunger" the highest and "Price" and "Tradition" the lowest.

3.1.3. Perceived product characteristics

The FRS results reveal variation in how participants perceive product formats, however, the differences were minor across formats and SD's large across all categories. MRP received the highest scores for familiarity, taste, liking, and convenience. Savoury Meal scored highest for healthiness, and RTD for naturalness and desirability. Conversely, the bar scored lowest for familiarity, healthiness, and naturalness, while the RTD scored lowest for convenience (**Table 4**).

Table 2

Sample characteristics with frequencies displayed.

Demographic		
	N	*%*
Ethnicity		
White	204	67.2
Mixed/Multiple Ethnic Groups	9	3.0
Asian	19	6.2
Asian British	9	3.0
Black	24	8.5
Black British	8	2.6
Caribbean	1	0.3
African	25	8.2
Other	3	1.0
Dietary Pattern		
Vegan	8	2.3
Vegetarian (all variations)	26	8.5
Pescatarian	19	5.9
Omnivore	240	80.7
Other	9	2.6
Annual household income (£)		
<£5,200	23	7.5
£5,200-£10,399	20	6.9
£10,400-£15,599	22	7.2
£15,600-£20,799	27	8.9
£20,800-£25,999	43	14.1
£26,000-£36,399	70	23
£36,400-£51,999	57	19
£52,000-£77,999	31	10.2
>£78,000	9	3.3
Employment status		
Full-time employment	182	60.3
Part-time employment	60	20.0
Unemployed	18	5.9
Retired	11	3.6
Homemaker	8	2.6
Caregiver	2	0.7
Student	14	4.6
Other	7	2.3
Highest qualification		
No formal qualifications	10	1.3
Secondary school e.g., GCSE	33	10.8
Further/higher education e.g., A-Levels	58	19.3
Undergraduate degree e.g., BSc (Hons)	131	43.5
Postgraduate Master's degree e.g., MSc	54	18.0
Postgraduate Doctorate Degree e.g., PhD	14	4.6
Other	2	0.7

Table 3

Participants' characteristics modified from The Eating Motivation Survey (TEMS) characteristics listed in order of motivation driver and Food Neophobia Score (FNS) Mean (M) and Standard Deviation (SD)

	Mean (M)	*Standard Deviation (SD)*
TEMS		
Need and Hunger	*5.30*	*0.97*
Habit	*5.25*	*0.87*
Health	*4.98*	*1.26*
Convenience	*4.85*	*1.29*
Liking	*4.76*	*1.33*
Price	*4.51*	*1.36*
Tradition	*4.27*	*1.29*
Naturalness	*4.08*	*1.50*
Processing	*3.94*	*1.29*
FNS	*38.8*	*6.81*

3.2. Conjoint Analysis

The relative attribute importance for each product format is detailed in **Figure 2**. Across the different product formats—Bar, Savoury Meal, MRP, and RTD-, "processing" consistently emerged as the most influential factor, except for bars, where "price" ranked the highest, followed by "processing". "Nutritional claims" played a consistent yet moderate role

(ranking third in importance) across formats. Participants considered nutritional claims the most in MRP formats. "Health messaging," was consistently lower than "processing", "price" and "nutritional claims" across all formats. In bar and savoury meal formats, "health messaging" ranked the lowest attribute, while in MRP and RTD, "health claims" ranked second from the bottom of importance. "Sustainability" also had a low impact across all formats. MRP and RTD ranked "sustainability" as the lowest attribute, while the bar and savoury meal ranked "sustainability" rating, second to lowest.

McFadden's pseudo-R^2 values suggested that for each product format, the attributes considered account for a substantial portion of the variability in consumer choices, with the Savoury Meal format showing the highest explanatory power (Bar 65.3%, Savoury Meal 66.7%, MRP 66.5% and RTD 66.6%).

Figure 3 reveals that consumers were most likely to select product combinations when they were "non-processed" or "minimally processed". Nutritional attribute levels stating "high protein" and meeting the "Nutrient Reference Intake (NRI) for vitamins and minerals" were relatively more likely to be selected, especially in Bars and MRPs, whereas "reduced-calorie and "low-fat" options were less likely to be selected. Price sensitivity was evident, particularly in the Bar format. Health messaging suggesting "Contributes to the growth and development of muscle" was preferred across formats, above all other health messages, whereas "aids skin, hair and nails" was less likely to be selected. Sustainability messaging "recyclable packaging" and "locally sourced" attributes were more likely to be selected (except for the MRP and Savoury Meal). Interestingly "plant-based" and "CO_2" messaging was relatively less likely to be selected (except MRP).

3.3. Familiarity and perceptions of the term ultra-processed foods (UPF)

In the sample, 83% of participants reported familiarity with the term "Ultra Processed Food". The results of the content analysis of the free-text responses are presented in **Table 5**.

4. Discussion

This study was the first to employ conjoint analysis to explore the trade-offs consumers make when considering processing level alongside other product attributes. Additionally, we investigated UK consumers' understanding of the term "UPF" through open-ended responses. In support of H1, our conjoint analysis results indicated that the "processing" attribute level labelled as "ultra-processed" had a negative effect on the conjoint utility scores, whereas "unprocessed" and "minimally processed" were relatively positive. This suggests that food processing is indeed a critical factor in consumer decision-making. Moreover, when considering the attribute level, processing was more influential than other factors such as nutrition, health, sustainability. Price was the most influential factor only for the bar format, only partially supporting H2.

Processing emerged as the most influential attribute in three out of the four product formats tested (Savoury Meal, MRP, RTD), underscoring consumers' sensitivity to the term "ultra-processed." This finding aligns with broader industry trends that emphasise naturalness and transparency in food production (Sanchez-Siles et al., 2019), highlighting the growing consumer demand for less processed, more transparent food options (Meijer et al., 2021). This contrasts with existing conjoint studies, which often show price as the highest influential attribute (Zhao et al., 2021). The relatively lower importance of nutritional claims, health messaging, and sustainability in consumer decision-making aligns with existing research, where price remains dominant (Baker et al., 2022). However, research focused on functional food products indicate that health claims are more influential than price (Annunziata & Vecchio, 2013). With respect to nutrition and health claims in the current study (which ranked third and fourth/fifth), it was evident that positive nutritional claims were much preferred e.g, "high in protein" and "contains 100% of daily NRI vitamins and minerals ",

Table 4

Sample Food Rating Scale characteristics with Mean (M) and Standard Deviation (SD)

Food Rating Category	MRP		Savoury Meal		RTD		Bar	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Familiarity	24.06	29.08	20.99	26.92	22.8	28.71	17.92	24.09
Tastiness	20.67	24.85	18.79	23.99	19.31	24.55	17.53	22.93
Healthiness	16.42	21.05	20.66	24.95	17.16	22.29	15.94	20.66
Naturalness	20.45	24.67	19.33	23.59	21.39	25.53	18.81	23.09
Convenience	30.84	35.15	26.48	31.43	23.71	30.71	25.99	31.95
Liking	23.5	28.09	21.25	26.52	23.1	28.13	20.42	26.01
Desire	28.09	31.95	26.94	30.83	28.43	32.11	24.99	29.87

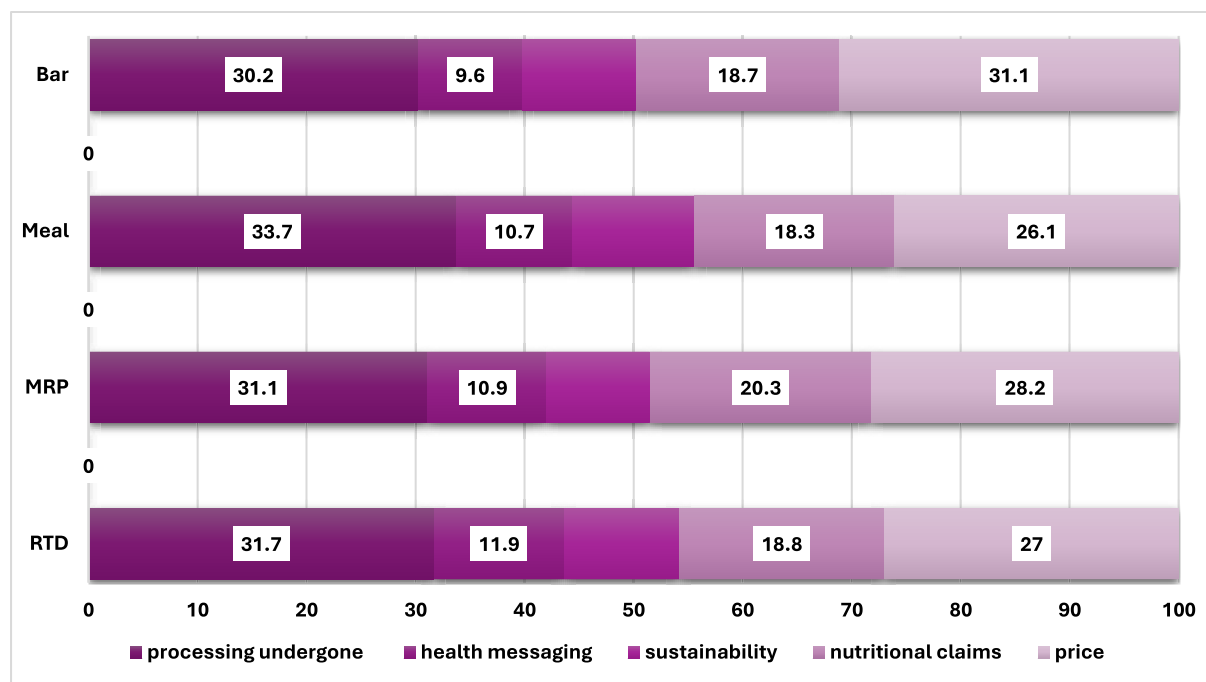MRP= Meal Replacement Powder, RTD= Ready-to-Drink

Figure 2. Relative attribute importance is displayed as percentage per product format for the overall sample (N = 302).
Meal = Savoury Meal, MRP= Meal Replacement Powder, RTD = Ready-to-Drink

rather than "low fat" or "reduced calorie (Kcal)" which aligns with trending attributes (Banovic et al., 2018; Williams et al., 2023).

Despite the rising interest in environmental sustainability, these attributes were less critical than processing level, price and nutritional claims in shaping consumer choices. This is consistent with existing research, which indicates that while consumers are increasingly aware of sustainability concerning human health, they tend not to make strong connections between healthier diets and environmental sustainability (Kenny et al., 2023). As a result, purchasing decisions are primarily driven by cost (Rihn et al., 2018) and convenience (Waldman et al., 2023), as these offer more immediate and tangible benefits to the consumer (Reisch et al., 2013; Steenhuis et al., 2011).

In line with Robinson et al. (2024) and Bolhuis et al. (2024) our mixed methods data further reveals that consumer awareness of the term "UPF" is high, and predominantly associated with negative health outcomes, chemical additives, and unnatural. Possibly shaped by media coverage, our open responses reflected themes around hyperpalatability and being unhealthy. But unlike Bolhuis et al. (2024), our results lacked nuance around any potential benefit of UPF (e.g., shelf life) and heterogeneity within the category of UPF, with relatively few mentions of 'extended shelf-life' and 'formulation to increase nutrition'. This highlights the great need for nuanced public information and guidelines regarding UPFs, particularly around any potential impact on health and sustainability, including positive.

This study contributes to our understanding of a well-known paradox in consumer preferences that while demand for healthier, more sustainable products is growing, there is still a strong preference for convenient, low-priced food options (Fernqvist et al., 2024). Often the low-priced convenient food options are processed and may or may not have health or sustainability credentials, yet our data shows processing is a concern. Consumers need additional guidance to effectively navigate this complexity.

Our sample included a considerable demographic range, though not analysed as a function of age in this study. Existing literature reveals younger consumers gravitate toward foods categorised as UPFs due to convenience, affordability, and taste (Howse et al., 2018). In contrast, older consumers are more likely to focus on the negative health implications of UPFs and the presence of additives (Robinson et al., 2024). A future study may consider replication of our current approach but with these specific consumer segments purposively sampled. This is particularly important considering the potential variation in how different age demographics perceive and prioritise product attributes and formats. Hetherington et al. (2024) showed that older adults were reluctant to accept meal replacement products due to the association of oral nutrition supplements with end-of-life care, poor taste, and displacement of "real food". Indeed, MRP and RTD products have historically often been
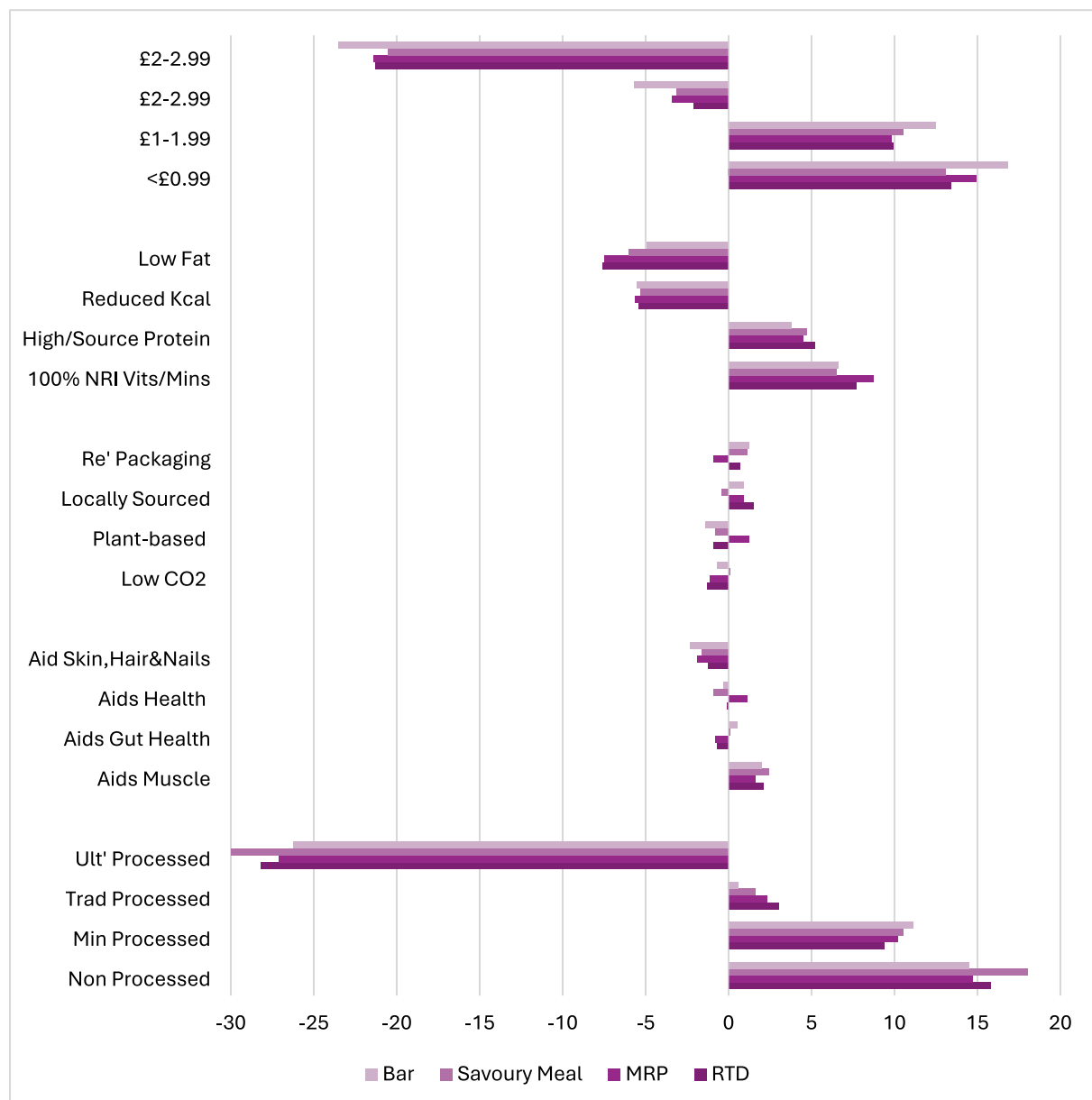
Figure 3. Preference utility scores per product format for the overall sample (N = 302).
Meal = Savoury Meal, MRP= Meal Replacement Powder, RTD = Ready to-Drink, Bar= Bar. Labelling abbreviations; 100% NRI Vits/Mins = Provides 100% of NRI of vitamins, and minerals. Re' Packaging = Recycled/recyclable packaging, Low CO_2 = Carbon neutral/CO2/low carbon footprint. Non-processed -non-processed/unprocessed, Min Processed = Minimally processed Trad Processed = Traditionally/moderately processed, Ult' Processed = Ultra Processed. Aids Muscle = Contributes to the growth and development of muscle, Aids gut health = Aids digestive and gut health. Aids health = Aids health and well-being, Aid Skin, Hair & Nails = Helps strengthen skin, hair, and nails.

positioned for clinical use, rather than promoting health and functional well-being. Yet, there is increasing acceptance of functional foods among middle-aged and older adults, driven by marketing that emphasises benefits such as preserving muscle mass and aiding health (Burke, 2023). This highlights the crucial impact messaging has on product acceptance, even when presented in similar formats and offering comparable nutritional benefits.

The increased sensitivity towards processing levels emphasises ultra-processing as an increasingly important factor in consumer decision-making and a prominent emerging attribute in consumer trade-offs. This reflects the growing influence of messaging around UPFs, indicating that the level of processing has become a critical factor in product acceptance. Our data shows that businesses marketing foods which are perceived as ultra-processed but belong in the subcategory of UPFs not

typically associated with adverse health outcomes, need to address this consumer concern directly. This stresses the necessity for clear and effective messaging to communicate the true nature of processing and to differentiate these products. Subsequently, building on the findings from this conjoint analysis study, a subsequent labelling study may be a fruitful future direction for research to explore optimal communication strategies

4.1. Strength and limitations

One of the strengths of this study is that participants were provided with an introductory cover story, meaning the true aim of the study was disguised, to prevent bias toward any particular attribute. While processing was our key focus, it was evaluated alongside other factors such

Table 5
Summary of key themes regarding the term ultra-processed foods.

Term themes	Total	Familiar *	Unfamiliar**
Processing and Production	*164*	*140*	*24*
Unnatural Characteristics	*108*	*89*	*19*
Sugar & Chemical Additive Concerns	*108*	*95*	*13*
Unhealthy & Negative to Health	*95*	*89*	*6*
Ingredient Complexity	*59*	*52*	*7*
Highly palatable and addictive	*20*	*19*	*1*
Extended shelf life	*15*	*14*	*1*
No longer 'real' food	*15*	*15*	*0*
Convenience	*11*	*8*	*3*
Made for maximum profit	*11*	*11*	*0*
Packaged/Wrapped in Plastic	*4*	*4*	*0*
High carbon footprint	*1*	*1*	*0*
Formulated to increase nutrition	*1*	*1*	*0*
Uncertain of the term	*12*	*6*	*6*

*= frequency of response from participants familiar with the term "ultra-processed foods". **= frequency of response from participants unfamiliar with the term "ultra-processed foods". 100% agreement was reached on theme categorisation.

as nutrition, health, sustainability, and price, rather than being the sole emphasis.

We displayed processing information explicitly; this could be viewed as a limitation as it is not currently displayed on products in the UK (whereas price, nutrition, and health claims often are), therefore drawing attention to an attribute that consumers may not usually consider. However, this could also be viewed as a strength as it directs us to what consumers think when processing is explicitly displayed.

5. Conclusion

This study is the first to apply conjoint analysis to explore the growing influence of food processing on consumer acceptance, with a particular focus on ultra-processing. The results reveal a shift in consumer priorities: while price once dominated decisions, processing levels, particularly ultra-processing, are now a key focus. These findings highlight the necessity for effective communication strategies that consider the nuances and heterogeneity within the category of foods considered 'ultra-processed'.

CRediT authorship contribution statement

Natalie Rouse: Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **James Collier:** Writing – review & editing, Conceptualization. **Louise Neilson:** Writing – review & editing, Conceptualization. **Chloe Mellor:** Data curation. **Emilia Urbanek:** Writing – review & editing, Supervision, Project administration, Funding acquisition. **Michelle Lee:** Writing – review & editing, Supervision, Project administration, Funding acquisition. **Jennifer Gatzemeier:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Laura L. Wilkinson:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Ethics approval and consent to participate

Ethical approval for the involvement of human subjects in this study was granted by Swansea University School of Psychology's Research Ethics Committee, review reference 2 2024 9028 8701 30/04/2024

Funding

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Natalie Rouse reports financial support was provided by Huel Limited. James Collier reports financial support was provided by Huel Limited. Louise Neilson reports a relationship with Twisted Orange that includes: employment. Laura L Wilkinson reports a relationship with Mondelez International UK Ltd that includes: funding grants. Chloe Mellor reports a relationship with Mondelez International UK Ltd that includes: funding grants. Funding received by Huel Ltd. Co-author James Collier, is co-founder and chief sustainability nutrition officer of Huel Ltd. This study was run as part of a Swansea University-funded scholarship. Participant payment costs were covered by Huel Ltd, along with the unbranded visual representations of the four product formats. The research team at Swansea University initially designed the study. Huel Ltd. was able to input into the design and methodology and endorsed the suggested approach. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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